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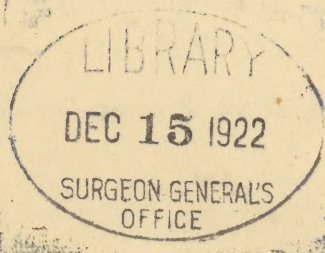
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ARTIFICIAL
CROWN-, BRIDGE-, AND PORCELAIN-WORK

EVANS

A PRACTICAL TREATISE
ON
ARTIFICIAL
CROWN-, BRIDGE-, AND
PORCELAIN-WORK

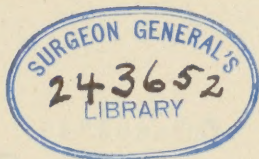
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✓
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NEW YORK STATE BOARD DENTAL EXAMINER; FORMERLY CLINICAL PROFESSOR COLLEGE OF DENTAL
AND ORAL SURGERY, NEW YORK; LECTURER BALTIMORE COLLEGE OF DENTAL SURGERY;
POST-GRADUATES LECTURER ROYAL COLLEGE OF DENTISTRY, TORONTO, CANADA;
MEMBER OF THE NATIONAL DENTAL ASSOCIATION: OF THE DENTAL SOCIETY
OF THE STATE OF NEW YORK; OF THE FIRST DISTRICT DENTAL
SOCIETY OF THE STATE OF NEW YORK; OF THE ODONTOLOGICAL
SOCIETY; OF THE AMERICAN ACADEMY OF DENTAL SURGERY;
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NINTH EDITION, REVISED

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WITH 1069 ILLUSTRATIONS AND SEVERAL PLATES ✓



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no 2

To

William Carr, M.D., D.D.S.

*in acknowledgment of his professional eminence
and his services for dental legislation and its en-
forcement in the State of New York, this volume
is respectfully inscribed by*

THE AUTHOR.

PREFACE TO THE NINTH EDITION

Though it is but two years since the eighth edition was published, the advances made have necessitated considerable revision for this the ninth edition. Every effort has been made to include the best that the profession has to offer in thought and practice. Processes that time and the march of improvement have made obsolete have been omitted, when the omission would not interfere with the story of the progressive development of the art of crown- and bridge-work. The space so gained has been devoted to the presentation of the most approved ideas in operative procedures and practical constructive details. Pathological conditions and pulp conservation are discussed thoroughly and conservatively as becomes their importance to the crown- and bridge-worker. The advances in crown construction and in fixed and removable bridge-work are set forth, including especially the latest suggested improvements in the forms of attachments in removable work. In all departments preference is given to methods that cause the least removal of tooth structure. The object of the author is to give the student a complete working guide that shall lead him along conservative lines.

In this, as in former revisions, I have been guided by the opinions personally expressed to me and the teachings and writings of specially qualified members of the profession. In these respects I desire to acknowledge indebtedness to Drs. William J. Robinson, LeRoy W. Doxtater, James K. Burgess, John P. Carmichael and George Evans, Jr.

GEORGE EVANS.

55 WEST 39TH ST., NEW YORK.

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INTRODUCTION

OF the origin of the art of dentistry no one can speak with certainty, as its early history is shrouded in the mists of antiquity; but dental operations are recorded in very remote times.

References are made to the art in the writings of Hippocrates, in the fifth century B.C. Martial, the Latin poet, in the first century B.C., says of a Roman dentist, "Cascellius is in the habit of fastening as well as extracting the teeth." To Lelius he says, "You are not ashamed to purchase teeth and hair;" and adds that "the toothless mouth of Egle was repaired with bone and ivory;" also, that "Galla, more refined, removed her artificial teeth during the night."

Horace, in the same century, cites the case of the "sorceresses Canidia and Sagana running through the city and losing the one her false hair, the other her false teeth."

Galen, the celebrated physician, in the second century A.D., also speaks of the art of dentistry as being then practiced.

These early operations were limited to the extraction of offending teeth and the replacement of those which had been lost with substitutes that were retained in position by means of narrow bands or ligatures attaching them to the adjoining natural teeth, and without the use of plates. Crude as they were, they formed the first expression of the art of dentistry, a beneficent art from the beginning, in that it sought to remedy pathological or accidental defects. Confined to the simplest operations, it existed for centuries, and then was apparently lost during the Dark Ages, to reappear when the more general diffusion of knowledge ushered in the modern era of science and invention.

After its revival, dentistry, so much of it as was known, was in a measure a secret art, the practice of which even within the memory of men now living, was involved in mystery; but recent progress has lifted the veil, and dentistry, in the treatment of the teeth on correct, scientific, rational principles, has developed an art and a science which have given it honorable rank among the professions. In its twofold evolution it has absorbed from every available source whatever would broaden its science or perfect its art. It calls to its aid anatomy, physiology, pathology, chemistry, therapeutics, metallurgy, sculpture,

and mechanics, with each of which it stands in closer or more remote relation; and the practitioners of dentistry who have become the most eminent and useful have been men of broad attainments and great versatility of talent.

In the history of all progress, movements apparently of a more or less reactionary character are recorded. In the useful arts especially it is not uncommon to find a return to forms and methods formerly used, but long since discarded and forgotten. So in dentistry we find methods of treatment and modes of practice once in vogue but long fallen into disuse, revived with improvements and modifications that stamp them as practically rediscoveries.

These movements are not to be regarded as retrogressive, because the modifications which accompany the reintroduction of practical ideas and inventions attest them as real advances, and indicate clearly that the cycle of knowledge is ever widening with experience. This volume demonstrates how modern dentistry has utilized the principles of some of the simplest original observations, and by "proving all things, holding fast that which is good," has attained its present honorable position in both its scientific and artistic departments.

The history of dentistry of later years is, in brief, a recital of progress and improvement. The medical profession, recognizing the relationship prophylaxis of the mouth bears to the general health and the important sphere in oral surgery and prosthesis dentistry filled in the late European war, accept dentistry as a profession, an adjunct to their own. The United States Government so estimates the services of the dental profession in the Army and Navy as to commission members in the service.

Such is the position which dentistry has attained. Much of the progress which has made its present elevation possible must be credited to the dental profession of the United States, which has been justly termed the cradle of modern dentistry. Here the validity of the idea that scientific knowledge should form the basis of training for practice was first demonstrated by the successful establishment of dental schools; here the first journal for the interchange among dentists of thought and experience was founded; here the first association having for its object the uplifting and upholding of dentistry by the mutual helpfulness of its practitioners had its origin; here, in a word, dentistry was first divorced from mystery, here it first passed the narrow confines of a mere handicraft and earned for itself the right to be classed among the learned and liberal professions.

ARTIFICIAL CROWN- AND BRIDGE-WORK

MODERN artificial crown- and bridge-work belongs to the department of dentistry formerly termed "mechanical;" but the judgment, skill, and scientific information required in the selection and treatment of teeth and roots associates it with operative dentistry.

Modern crown- and bridge-work, properly understood and properly performed, takes high rank in dental art, and offers wide scope for versatility of talent and inventive genius. The varied and complicated cases presenting for treatment frequently suggest to the expert novel contrivances and methods of construction and application. Successful practice of crown- and bridge-work depends upon a thorough mastery of the underlying principles and expertness in the processes involved, governed by sound judgment and perfect candor. The interests of the patient should be paramount to every other consideration, and after a careful examination he should be given an accurate statement of the applicability of the system to his case, in respect to usefulness, appearance, durability, and comfort, as compared with other processes and appliances in use.

Surgical and mechanical operations of the most delicate nature are required. Nothing, indeed, in dentistry demands finer manipulation. A practical consideration of the subject will show that a knowledge of anatomy, pathology, and therapeutics, and as well mechanical and artistic skill, are necessary to the correct treatment of cases and the proper performance of the operations indicated. Among the principal steps in an operation may be named, first, the preparatory treatment of the natural roots and teeth for the final process, involving the diagnosis of present or probable lesions and the prescription of whatever remedial or prophylactic measures may be needful; second, in crown-work, the adaptation of the artificial crowns to the cervical portion of the natural roots and the contiguous membranes, and the restoration of the articulation and the anatomical contour; and, in bridge-work, the selection of suitable teeth or roots for foundation piers or abutments, and the choice and adaptation in constructive practice of the forms which will insure the highest degree of stability and best sustain the force of occlusion, thereby avoiding abnormal positions and conditions.

In no branch of dentistry will lack of knowledge and skill or the exhibition of carelessness in constructive details be more plainly evidenced or result in greater proportion of injury instead of benefit. Many failures are to be attributed to attempts to perform bridge-work operations with about the same expenditure of time on the part of the dentist and financial expenditure on the part of the patient as in plate-work. There is no such relationship between these two methods of procedure.

The practice of crown- and bridge-work by dentists possessing the requisite attainments and governed by correct ethical principles gives results which have gradually established its value, removing erroneous impressions and insuring a wide professional and public indorsement of this important branch of prosthetic dentistry. Its extraordinary facilities for preserving and replacing teeth have made for it a high position in dental art.

PART I
MATERIALS AND PROCESSES USED IN
CROWN- AND BRIDGE-WORK

CHAPTER I

PREPARATORY REQUIREMENTS

A complete equipment for crown- and bridge-work, as will be seen from the list following, embraces, besides many instruments, materials and appliances from both the operative outfit of the practicing dentist and the dental laboratory. Not all of these are necessary for the beginner, but he will find, as he advances, that all of them will be required in the work itself or the preparatory surgical procedures.

Instruments

Swiss and Donaldson broaches.

Kerr's Pulp-Canal Files, all sizes; also Reamers for hand use and straight hand-piece and right-angle attachment.

Gates-Glidden drills—all sizes, straight and for right-angle attachment.

Root-canal probes and pluggers.

Root-canal reamers, Peeso's.

Enamel O. S. cleavers (Orton's). See page 122.

Root shapers—cross-cut cone-shaped trimmers (Evans). See page 122.

Root facers, Nos. 7-8-9. 122

Carborundum wheels, disks and points. See page 120.

Tools

Pliers for shaping collars—Peeso No. 118, Robinson No. 120, contouring No. 130. See pages 148 and 156.

Pin roughening and bending pliers, No. 127.

Cutting pliers.

Small pointed shears, straight and curved, Nos. 10 and 11. See page 152.

Plate burnisher No. 1.

Pin vise No. 4.

Small anvil. See page 150.

Hammer-headed hand-vise— $\frac{7}{8}$ inch jaw.

Tweezers, C, N, O, L. See page 149.

Solder tongs. See page 138.

One round file, fine.

Two half-round files, 3 in. No. 6 cut, and 5 in. No. 2 cut.

Two flat files, 5 in. No. 2 cut, 5 in. No. 6 cut, one side smooth.

Bunsen burner with spider—See Part I, Chapter IV.

Asbestos soldering block—See Part I, Chapter IV.

Charcoal soldering block—See Part I, Chapter IV.

Hand-Blowpipe—See Part I, Chapter IV.

Ladle for melting fusible metal—See Part I, Chapter III.

Small impression cups—See Part I, Chapter IV.

Small articulators—See Part I, Chapter IV.

Gage plate Standard Wire-gage (Brown and Sharpe).

Crown swager with steel blank and rubber plunger (S. S. White) and Peeso's swaging device No. 2 for flattening plate.

Die-plate for forming occlusal cusps.

Cusp buttons, an assortment of. See Fig. 269.

Precious Metals

Pure gold plate, Nos. 28 to 34 gage, and No. 40 gage to form matrices for occlusal cusps.

Gold plate, 22-carat, Nos. 28 to 30 gage.

Gold clasp, No. 24 gage.

Platinized gold wire, round, Nos. 12, 14, 16, 18, 20 and 21.

Platinized gold wire, half round, Nos. 12, 13, and 14.

18- and 20-carat solder; also hard-flowing solder.

Platinum plate. Nos. 32 to 40 gage for collars and backings.

Platinum foil, $\frac{1}{1000}$ and $\frac{1}{2000}$.

Iridio-platinum wire, Nos. 15 and 17 gage for posts and Nos. 19, 20 and 21 gage for pins in either gold tips, inlays or crowns.

A few dwts. of silver solder for special purposes.

Porcelain teeth; a small assortment of cross-pin plate teeth (facings) and porcelain crowns of light, medium and dark shades, consisting of incisor, cuspid, bicuspid and molar forms, is very convenient to have on hand.

Base Metals

Fusible metal.

Amalgam for models.

Sheet copper, Nos. 30 to 38 gage.

Spool each of iron and copper wire No. 31 gage for measuring.

Iron wire about No. 17 to 18 gage for encircling investments and other purposes.

German silver plate or platinoid, No 30 gage, and wire No. 12 to 20 gage.

Materials and Accessories

Impression compound in cakes.

Impression compound in sticks.

Wax, stiff, in sheets.

Cement wax.

Inlay wax.

Finely ground silex or calcined marble-dust.

Moldine.¹

A small rolling-mill for plate will be quite an acquisition, as gold scraps can be remelted and formed into plate, and plate on hand can be reduced to any desired gage.



FIG. 1.



FIG. 2.

For porcelain work an outfit of both high and low-fusing porcelain body, to be used for inlay or crown work. See page 477.

Six plug-finishing burs Nos. B, C, D, 200, 201, and 246.

Two inlay burs Nos. 1 and 2.

Three camel's-hair brushes—small, medium and large.

One gem cavity trimmer No. 5.

A double end spatula for porcelain work. (Capon.)

Several fire-clay slabs for holding the work while baking.

Pulverized silex.

A set of suitable burnishers for adaptation of matrices, long handles, Nos. 25, 26, 27, and 28.

Locking tweezers "K." Fig. 232.

¹ Introduced by Dr. G. W. Melotte.

An electric furnace, preferably with a pyrometer (see Fig. 482).

A bench on which the principal parts of the work are done should be especially designed and reserved for it. It may be in the same room, conveniently situated a little behind the dental chair out of view of the patient or located nearby in an adjoining room. Everything connected with the bench should be kept in order and ready for immediate use. Such a bench of oak or mahogany with a top that can be closed when not in use, making an unobjectionable piece of furniture, is represented in Figs. 1 and 2.

The Bunsen flame in the center of the bench can be turned off and relighted instantly by a small jet at the side of the burner. The joint of the socket of the gas bracket is formed so that when the bracket is pushed to one side for the purpose of closing the cover of the bench, the gas supply is shut off. Large and small soldering with the regular gas blowpipe may be done at this bench; also soldering by the open flame; but the laboratory is a more suitable place for the former, as the smoke emanating from a blowpipe will gradually soil the adjacent walls and ceiling.

A small electric lathe-head can be mounted on the bench.

CHAPTER II

PLATES, SOLDERS AND FLUXES¹

In the construction of crown- and bridge-work, gold and platinum are used pure and alloyed with other metals of the platinum group, or with silver and copper as best suits the requirements of the work and the preference of the dentist.

Platinum.—Platinum retains its color and resists the action of the secretions of the mouth better than pure gold. For this reason and also because of its physical properties respecting malleability and ductility, as well as its extremely high fusing-point when formed in any gage of plate or foil, it is a very useful material in many departments of the work. Platinum is also valuable as an alloy to raise the melting-point of gold plate and increase its tensility.

Platinum plate gages Nos. 31 to 35 and when reinforced with pure gold as thin as No. 38 gage, is used for forming collars for crowns.

Platinum Foil and Wire.—Platinum in the form of thin plate from No. 40 gage to that of foil, and of wire, gages No. 21 to No. 14, is used in various operations associated with the work.

Platinum foil can be made exceedingly thin by first rolling it down to about 1/1000 of an inch, annealing in an electric furnace, then oiling the surface, doubling over and again rolling down. Treated by this method the metal is less liable to crack.

Platinum and Gold for Collars.—In some cases platinum can be utilized to advantage for making collars at from Nos. 36 to 38 gage. The collar, when fitted, is stiffened by the addition of pure gold melted over its outer surface.

Iridium.—Iridium as an alloy for platinum imparts hardness and elasticity. The usual proportions are 10 per cent. iridium and 90 per cent. platinum. Iridio-platinum wire of the same gages as platinum wire for the same purposes is employed for posts and pins when greater rigidity is required than pure platinum affords. Palladium is also used as an alloy instead of iridium.

¹ The subject of plates and solders is here discussed only in relation to crown- and bridge-work operations. For an extensive consideration of their properties the reader is referred to works on Metallurgy.

Gold.—Gold plate, 24 carats, gages No. 28 to No. 36, is generally used for backing porcelain teeth and forming collars where great flexibility of metal is required; also, as thin as 4/1000 inch, cut in a strip five-eighths inch wide, when to be stamped up as a cusp-cap to act as a matrix for coin gold.

The plate is slightly alloyed, about 23 carats fine, for crown-work when a less flexible metal is required; gold plate, 22 carats, gages Nos. 29 to 31, in constructing collars for crowns with porcelain facings, all-gold crowns made in sections and seamless crowns. Gold plate of 20 carats is also used in the construction of bridge-work.

Gold for constructing collars should be of as high a carat as possible to better resist the action of acids. A large proportion of copper as an alloy is objectionable, owing to its tendency to cause tarnishing of the collar when an acid condition of the mouth exists.

Gold Alloys.—United States gold coin is much used in crown- and bridge-work, owing to its flexibility, strength and the fine finish of which it admits. As it contains 10 per cent. of copper, it is not as well able to resist oxidation in the mouth as some other alloys that closely resemble it in commendable properties.

Formulas for Crown-work

The following is the author's formula for gold plate for crown-work:

Pure gold.....	36
Platinum.....	3
Coin gold.....	61
	100 parts

The platinum and pure gold should be melted together first, rolled out and cut into small pieces. The coin gold is next melted and the platinized gold added. The alloy closely resembles coin gold in color, flexibility and strength. It is much higher fusing, the joints of collars and crowns made of it can be soldered with coin gold and it will permit the use of high-grade solders with less risk of fusing the parts than when coin gold or ordinary 22-carat plate is used.

CAP CASTING ALLOY¹

22-carat gold plate.....	2 parts
Clasp gold	1 part

This formula contains about 4 per cent. of platinum and is for casting root-cap and crown attachments.

¹ Formula of Dr. Edward T. Tinker.

Clasp Gold.—The following alloy possesses resiliency and is of good color:

Pure gold.....	20 dwt.
Platinum.....	4 dwt.
Silver.....	2 dwt. 20 grs.
Copper.....	1 dwt. 18 grs.

The above formula cannot be properly fused in less than one ounce lots. The platinum must be thoroughly alloyed with the pure gold before the addition of the other metals.

Gold Alloy for Lugs.—For lugs requiring strength and rigidity the following is suggested:

80 parts of.....	SSW Clasp gold
20 parts of.....	18-carat gold plate

Gold Platinum-Lined Plate.—Gold plate 24 carats, with a lining of platinum, can be used in any of the processes of crown- and bridge-work, and is recommended to the inexperienced because the melting of a part of the crown in the soldering process is less liable to occur by its use. It is formed by fusing a thick layer of pure gold over a piece of platinum about gage No. 30 and passing through a rolling mill. In soldering the seam of union of a collar made of this style of plate, the ends of the metal require to be clamped together until they are united by the solder, as otherwise the unequal expansion of the gold and platinum will spring them apart and open the seam.

Platinized Gold.—An alloy of pure gold with from 1 to 3 per cent. platinum may be used to advantage in various operations. Gold so alloyed is but slightly affected in color and is very flexible. Plate of this alloy can be used exceedingly thin with much less liability of being melted than pure gold.

Melting and Refining of Gold Scraps.—The conversion of gold scraps into plate is desirable from an economic standpoint.

Passing a magnet through scraps or filings will remove particles of iron. A moderate quantity of clean scraps, using plenty of borax, can be melted with a gas blowpipe and allowed to cool in a depression of the soldering-block. For a large quantity use a small crucible well lined with borax, fuse in a gas or charcoal furnace and pour into a warm ingot-mold. The gold should be allowed to cool slowly and should never be removed from the ingot-mold and immersed in water while still hot. When cool the ingot should be boiled in acid, cleaned, hammered out, annealed and rolled in a mill to the desired gage.

Filings and scraps containing particles of solder should be melted

and refined by the "dry process." This consists in placing the scraps in a crucible lined with borax, fusing at a high heat for a considerable time and applying potassium nitrate (saltpeter).

Gold Solders.—The grade and character of solder are important in crown- and bridge-work operations. The solder should approach the fineness of the plate used, exhibit strength and elasticity when in plate form and melt and flow smoothly under the properly applied heat of the blowpipe.

The production of solder of uniform quality requires a knowledge and skill only possessed by those constantly engaged in its manufacture. For this reason, although some operators alloy and make their plate and remelt their scraps, very few prepare their solder. When purchased, the name 18- or 20-carat solder does not imply that it will assay eighteen or twenty carats fine, respectively, but that the figure gives the grade of plate for which the particular solder is adapted.

18- and 20-carat solders are used for crowns and bridges, although some dentists consider 18-carat too low for the purpose. 22-carat solder is seldom used except to solder the joint of a collar or on the exposed outside surface of a gold crown. 14-carat solder is used only in filling the cusps of seamless crowns in single crowning operations and in some repairing operations.

The following is the proportion for 18-carat solder generally given in text-books:¹

Pure gold.....	18	grs.
Silver.....	2	grs.
Copper.....	3	grs.
Zinc.....	1½	grs.

The burning out of approximately one-half grain of zinc gives a solder close to 18 carats fine. Increase the copper slightly to darken the shads.

Solder may be made by alloying the same grade of plate upon which the solder is to be melted. For such an alloy a soft quality of fine brass wire is the best. Spelter solder is also used. The following formula is an example:

22-carat plate.....	4	dwt.
Fine brass wire.....	12	grs.

Allowing for the alloy already present in the 22-carat plate, the result is a solder fully 19 carats fine. A smaller proportion of alloy added to the 22-carat plate will give a corresponding result; for example, 2 grs. to each dwt. will produce a solder about 20 carats fine.

¹ This is the formula generally asked for at State Board Examinations.

Dr. W. H. Dorrance many years ago supplied the following practical formula¹ for an alloy for the formation of different grades of gold solder, the proportion of the alloy used determining the melting-point and fineness in carat of the solder:

Pure silver.....	1 part
Pure zinc.....	2 parts
Pure copper.....	3 parts

The silver and copper are first melted together in a crucible lined with borax and the zinc added quickly in small pieces, stirring the mass meantime with a clay pipe-stem. On the fumes of the zinc passing off, it is immediately poured into an ingot-mold or a large wooden pail filled with water. 4 grains of this alloy melted with 20 grains of pure gold will result in a solder fully 20 carats fine.

Hard Gold Solder.—The term “hard solder” may be applied to any formula or carat of gold when used as a solder on one that is higher fusing. Thus, coin gold is so called when used to solder pure or platinized gold and pure gold when used to solder platinum or platinized gold. It is also applied to the successively higher grades in carat of the ordinary gold solders in which a gradually smaller percentage of zinc is used.

An 18-carat grade of “hard solder” is conveniently made by melting together by weight, one-third 18-carat solder to two-thirds 18-carat gold plate; 20-carat solder and plate can be used in the same proportions to form a higher grade. The plate is first melted and the solder added and, when cool, rolled out to the desired gage.² To form a lower flowing solder for use in successive stages of the work, melt together one part gold solder by weight, to one part of gold plate.

Peeso Formulas³

No. 1.—COIN GOLD SOLDER

Coin gold.....	8 dwt.
18-carat solder.....	3 dwt. 8 grs.
Pure copper.....	18 grs.

No. 2 formula makes a solder 21 carats fine.

These two alloys as solder flow freely and are excellent for use on coin gold.

No. 2.—HARD FLOWING SOLDER

Melt together equal parts of coin gold and Formula No. 1 solder.

Fluxed Solder Filings.—Fluxed gold solder filings are made by filing with a clean flat plate-file a thick piece of solder held in a vise.

¹ This formula is used by the author when he makes solder. It is convenient and reliable, and with it any grade of alloy is quickly formed.

² Formula most used by the author.

³ Dr. F. A. Peeso.

The filings are allowed to fall into a box or on a sheet of paper placed to receive them. A magnet should be passed through the filings to remove any minute particles of steel from the file. To five parts of the filings so prepared is added and well mixed with them, one part of Parr's prepared flux or finely pulverized vitrified borax. As a vehicle with which to apply the filings in soldering, add enough vaselin to form a paste. Solder prepared in this form is useful for strengthening crowns and also in fine soldering operations, such as uniting the joints of a collar, as the particles of solder take the heat separately and fuse much more quickly than when the solder is cut in pieces. The flow of the solder is also more easily defined and limited.

Platinum Solder.—Platinum solder is made by alloying pure gold with 10, 15, 20, or 25 per cent. of platinum and fusing with a compound blowpipe. 30 per cent. platinum solder withstands the very highest heat ever used in the fusing of porcelain. Platinum solder is used to unite the platinum sectional frame-work of a crown for porcelain-work or for a casting operation. The grade of solder to be used is determined by the fusing point of the porcelain. 10 per cent. may be used to solder seams of platinum caps when pure gold is to be cast over it.

Silver Solder.—Silver solder is frequently used by the student and practitioner in the construction of tubes for impressions and in the construction of experimental or specimen work made of coin silver, nickel or German silver.

A reliable formula is:

Coin silver.....	90 parts
Zinc.....	10 parts

Low fusing silver solder:

Coin silver.....	50 parts
Spring brass wire.....	50 parts

Flux.—The object of flux is to prevent oxidation of the metal when heated and thus permit the portion which is fused to flow freely and unite with the surfaces of the higher fusing metal. The lower grades of alloys require more flux than the higher grades, as is evidenced in the soldering of platinum with pure gold. The quantity of flux applied to the work for soldering should be limited to that which will accomplish the desired object. An excess of flux affects the control of solder, forms pits and is liable to reach and check porcelain by fusing upon its surface.

Borax is the preferred flux for soldering dental work. For small fine soldering and deeply invested sections it should be ground with

water on a slab and applied with a fine camel's-hair brush before heating the metal or investment. For application during soldering it should be first vitrified and then ground to a fine powder. Vitrification divests borax of its water of crystallization and in this vitrified form, when powdered, it can be sprinkled on the metallic sectional parts of the work and fused without disturbing their position through expansion, which is liable to occur when ordinary pulverized borax is used. Preparations of borax should be kept perfectly clean, as the invasion of foreign matter will cause pits in the solder.¹

Dental solder of a higher grade than that ordinarily used in the arts requires more heat. As borax melts at a comparatively low heat, its tendency is to flow off the prominent points of the metal and expose them. Consequently, as the addition of boric acid raises the fusing point of the flux, it tends to increase its efficiency.

A formula² for solder flux is:

C. P. borax glass (fused).....	55 parts
C. P. boric acid (not fused).....	35 parts
C. P. silica.....	10 parts
	100 parts

The ingredients are fused at a red heat in a fire-clay crucible and poured into cold water, then instantly removed, dried, pulverized and passed through an 80-mesh sieve. This flux is applied in the powdered form, or mixed with vaselin to form a paste, or dissolved in boiling water and the saturated solution applied.

Jewelers' Liquid Flux.—Jewelers' liquid flux may be used in some parts of the work in place of vitrified borax or flux. It is made of a saturated solution, equal parts borax and boric acid in water. It should be applied to the parts with a brush before heating and the heated point of a strip of solder dipped in it before application.

¹ Dr. Parr's "Prepared Flux," a finely pulverized vitrified flux, can be used in this manner. It is also prepared in combination with wax cement. In the melting out of the wax when the case is invested and heated for soldering, the flux is carried into the interstices.

² Mr. L. J. Weinstein's formula.

CHAPTER III

MATERIALS. PORCELAIN TEETH

Fusible Alloys.—Of the many fusible alloys of tin, the following—in parts by weight—will be found suitable for use in crown- and bridge-work.

Formulas

Tin	Lead	Bismuth	Melting-point Deg. Fahr.	
5 ¹	3	8	202	
3	5	8	212	
1	2	2	236	
Tin	Lead	Bismuth	Cadmium	Melting-point Deg. Fahr.
3	4	8	2	150
2 ²	3	5	2	180

Fusible metals should not be heated beyond their melting points, a matter which is not as a rule carefully observed, and, after fusing,

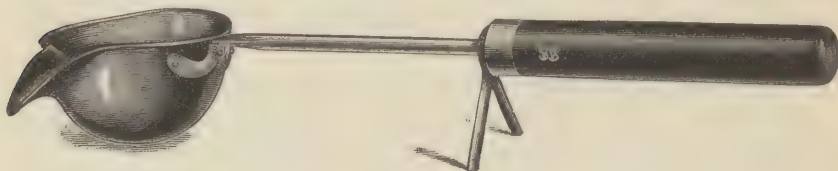


FIG. 3.

should be allowed to cool moderately before pouring. A ladle, such as is illustrated in Fig. 3, with legs to prevent tipping while cooling, is a suitable form.

Impression Compound.—Impression compound is for taking impressions of teeth for crown and inlay work. When an impression of the interproximal or other small space between the teeth, is desired, it is best obtained by first placing and pressing a small thin piece of the material used, into the space or spaces to be taken before pressing the main mass in the impression cup to position in the mouth.

¹ Dr. G. W. Melotte's formula.

² Dr. G. Molyneux's formula.

Impression compound is softened by warm water or dry heat, preferably the former. It should be partly or entirely hardened by chilling with cold water before removal.

Dental Lac.—This is a preparation resembling sealing-wax. It is very hard and tough for a material of its kind, and softens and hardens very quickly under the application of heat and cold. It is softened for use by holding it in the heat above an alcohol or Bunsen flame. Dental Lac will maintain its form in the swager in stamping thin soft gold or platinum plate.

Moldine.—This is a preparation compounded of potter's clay and glycerin. More glycerin may be added when the moldine becomes hard. It is of putty-like consistence and is useful in forming molds of teeth or occlusal surfaces from a model shaped either in wax or plaster, which is to be cast in fusible metal.

Wax Cement.—Wax cement is used in two forms, adhesive and hard wax. Adhesive wax when moderately heated is quite flexible, adheres readily to metal and porcelain, and may be manipulated with the fingers without sticking to them. When chilled with cold water, it becomes quite hard. It is to be used during the adaptation of different parts of the work in and out of the mouth.

Adhesive wax of a suitable quality can be made of pure yellow beeswax 4 parts, resin 1 part, and gum dammar 1 part, by weight.

Hard wax requires more heat to soften it than the adhesive kinds. When sufficiently heated it is very soft and adhesive, but exceedingly brittle when cooled. It is best used as a support to adhesive wax; the adhesive wax having been first applied in the preliminary adaptation of the work, as much as possible of it is removed without disturbing the position of the parts and replaced with the hard wax for the final adjustment.

Hard wax is made of yellow beeswax 1 part and resin 3 parts, by weight.

Wax cement when made in stick form is most convenient to use.

To Secure Adhesion of Wax to Metal or Porcelain.—Heated or melted wax when applied to a cold or wet surface does not adhere properly and is liable to loosen and cause displacement of sections of the fitted work. To prevent this, dry the metal or porcelain perfectly and heat it uniformly to a point that will fuse adhesive wax when touched to its surface. Veneer the surface of the metal or porcelain with the wax and allow it to partly or entirely cool. Wax then applied will firmly adhere to the wax veneer.

Porcelain Teeth or Facings.—The artificial teeth chiefly used in crown- and bridge-work operations are termed porcelain facings.

Essentials of Porcelain Teeth.—The qualities requisite in porcelain tooth body for use in crown- and bridge-work are density, strength and the power to withstand unaltered in form or shade any degree of heat to which it may necessarily be subjected. In these respects the porcelain teeth of our best American manufacturers seem to excel. They afford at the same time those other essentials, artistic imitation of the natural teeth in form and shade, and practical location of the pins.

Fractures in Porcelain Teeth or Facings, Causes of.—Porcelain facings are sometimes fractured in soldering by the contraction of the backing when adapted over the edges of the porcelain in an acute instead of an obtuse angle, or by the melting of solder on some part of the porcelain which is unprotected by a backing metal. The cooling solder or borax contracting on the porcelain or a very thin edge of the metal covering it, will usually cause a fracture. The porcelain tooth has yet to be made that will endure such extreme treatment without breaking.

Porcelain facings set up for soldering with their sides touching are very liable to fracture by expansion. An imperceptible space of at least $\frac{1}{2000}$ inch should be left between them. Fractures are also caused by too rapid heating and, quite frequently, because the operator removes the work from the investment before it has become perfectly cool.

Changes of Shade in Baking and Soldering.—The shade of porcelain teeth is very slightly affected, if at all, by an ordinary soldering operation. Subjecting them to extremely high heat in a furnace tends to lighten the porcelain by burning out some of the metallic oxids or other compounds.

To closely determine the shade developed by soldering, which may at times be necessary in the restoration of one of the six front teeth, back the facing with $\frac{3}{1000}$ platinum, invest, heat slowly and reinforce the platinum substantially with pure gold. The shade thus developed will be very little affected subsequently, if at all, by the comparatively low heat required to fuse ordinary 18- or 20-carat solder. When this method is practiced only pure platinum pin teeth or facings should be used.

Repeated soldering operations and the use of alloys composed largely of the base metals tend to darken the shade of porcelain.

Veneers.—A veneer consists of a thin piece of porcelain representing the labial aspect of a natural tooth.

To form a veneer select a porcelain facing of the required shade and size. On the end of a piece of wood about the size of the facing, melt

and attach a mass of shellac, heat the porcelain facing and imbed the labial surface in the shellac, as shown in Fig. 4. Clip off the pins of the facing and with a carborundum wheel on the lathe grind down the porcelain uniformly to the required thickness. Heat the porcelain, release the veneer and remove all particles of shellac before the application of the veneer to the case.

To Change Shape or Contour of a Porcelain Tooth.—

Trim the surface of the porcelain to the desired form and polish, first with coarse carborundum disks, then with finer grades, finishing with cuttlefish and oxid of tin (putty). If the restoration of the original glaze is desired after polishing, place the tooth on pulverized silex on a fire-clay slab and heat in the electric furnace up to over 2400° for American and about 2000° for English manufacture. The porcelain will then appear with its original glaze.

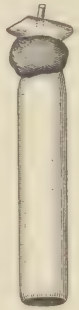


FIG. 4.

CHAPTER IV

APPLIANCES AND METHODS

Impression Trays.—In crown- or bridge-work operations, as an impression of only a portion of the teeth is generally required, partial impression trays are mostly used. Trays suitable for the right and

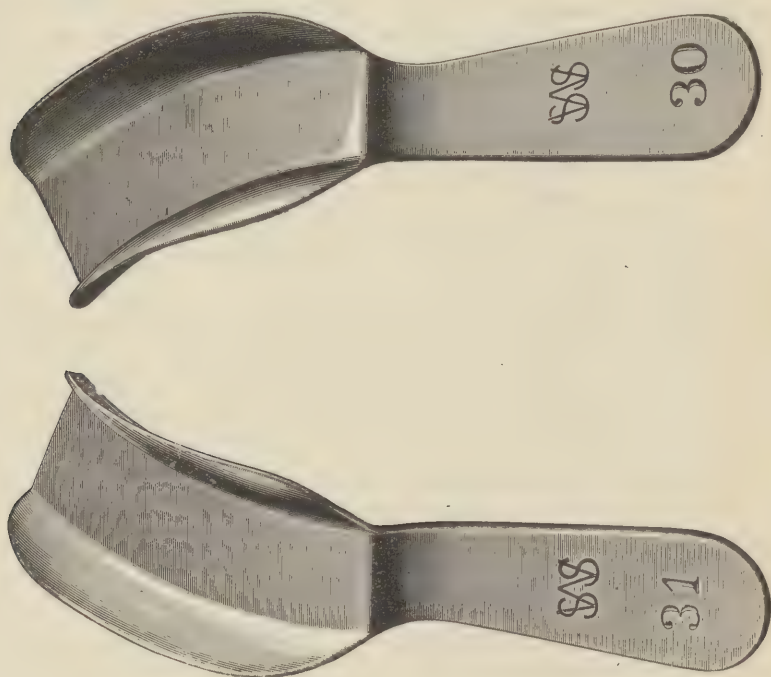


FIG. 5.

left sides and front of the mouth are illustrated in Figs. 5 and 6. They are of forms that favor the replacement of a plaster impression in the tray should it break or be disturbed in removal from the mouth. Fig. 7 is an adjustable partial impression tray. This device conveniently

takes the place of three trays. The tray proper rotates on a pivot, B, and is thus perfectly adapted for use in the front or on either side of the mouth, and is firmly held in position by the sliding guard A.

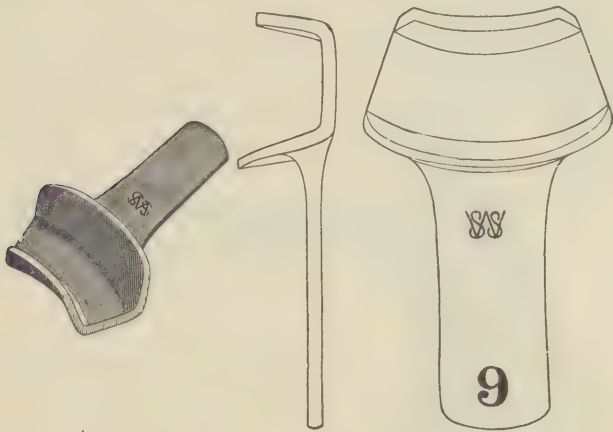


FIG. 6.

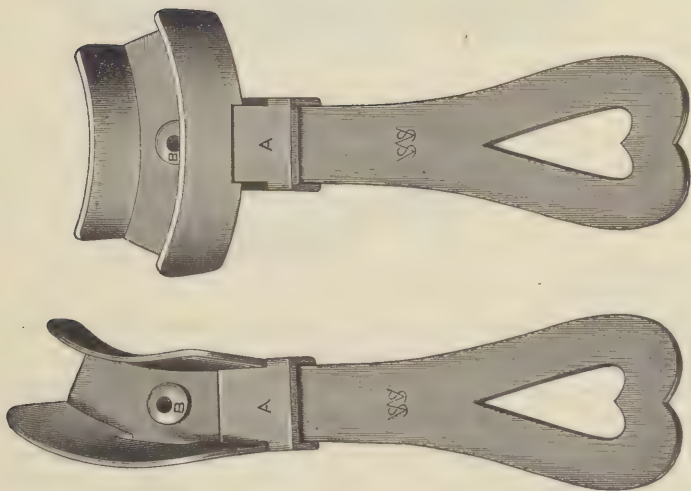


FIG. 7.

Articulators.—The ordinary and anatomical forms of articulators are used in bridge-work, especially the latter for large operations embracing both sides of the mouth. For small bridges or single crowns the partial or an anatomical articulator with a graduating support,

such as is illustrated in Fig. 8, is much used. Fig. 9 shows an anatomical articulator. (Kerr's.)

Impressions.—For the taking of impressions for bridge-work and for most operations in crown-work, plaster is most suitable. To simplify the separation of the impression from the model, a particle of carmine or other coloring material may be combined with the plaster in the mixing. Potassium sulfate, if added, will quicken the setting. The best method for the purpose is to dissolve a small teaspoonful

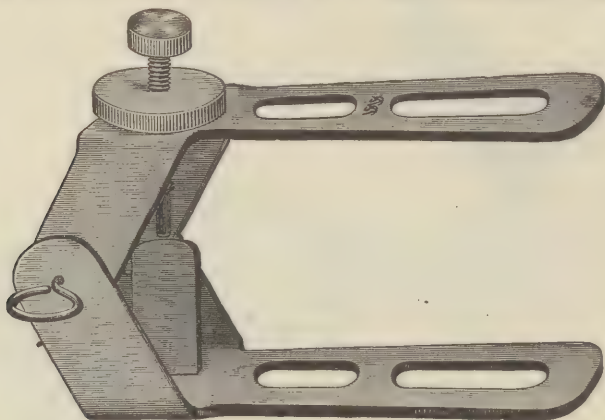


FIG. 8.

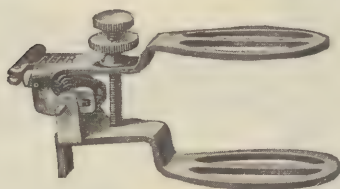


FIG. 9.

of the potassium sulfate in a pint bottle of water and thus always have it ready for use in the proper proportions. The improved impression compound is serviceable for impressions and "bites" for crowns and small bridges. It is softened with a moderate heat and quickly becomes hard again on the application of cold. It does not fracture as easily as plaster. This compound is much used for taking impressions for inlay work by the indirect method.

Sectional Impressions.—When the exact form of the contour of a tooth is required or when teeth tip toward each other in such manner that in the taking of an impression the mass of plaster that sets around or between them will not pull out, the best plan is to take the impression one half at a time with a split tray which is jointed in the middle

by a hinge. A brass hinge may be used to form a split impression tray, as shown in Fig. 10. An impression may also be taken in sections (Fig. 11). Take the lingual and part of the incisal or occlusal surfaces

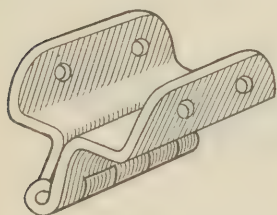


FIG. 10.

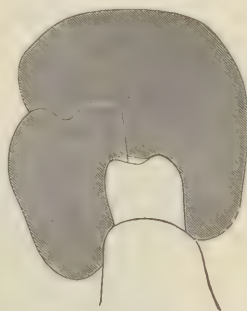


FIG. 11.

first, remove that section, trim, varnish and oil; replace in position in the mouth and apply plaster to form the remaining section. Separate the sections for removal from the mouth, replace and run the model.



FIG. 12.

An impression of this character may also be obtained by taking the lingual side first with impression compound and then the labial with plaster, so that it will include the entire occlusal and incisal parts. This method will sometimes simplify the taking of a difficult impression for bridge-work.

A method for use in contracted spaces for removal of abutment crowns in the impression, is to fit a piece of softened impression compound accurately in position between the overhanging teeth, so shaped that it will pull out of the plaster impression on removal, as shown in Fig. 12. The piece of compound is removed from its position in the mouth and replaced in the impression to complete the mold.



FIG. 13.

When the line of the interproximal space between certain teeth is required, it is best obtained by inserting between the teeth, before taking the impression, a piece of separating file, as shown in Fig. 13, or a strip of copper, single or doubled so that it fits the space closely, with the ends protruding, and removing it in the plaster.

In this class of work the surfaces of all plaster impressions that are to be run with plaster require to be thoroughly varnished and oiled.

Sectional Impression Trays

The Roach.—This is a hinge tray. Fig. 14 shows the tray closed with the handle in position. The size suitable for taking the impression of a single tooth is illustrated in Fig. 15.



FIG. 14.

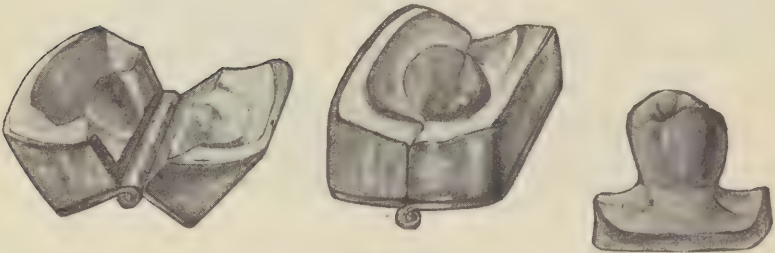


FIG. 15.

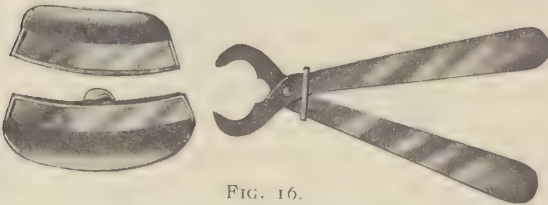


FIG. 16.



FIG. 17.

The Kidder.—This form separates in two sections with a flange in the center which fits into a socket on the other, the two sections being

held together by a clamp-handle (Fig. 16). Fig. 17 shows the tray closed, with V-shaped slots allowing it to be bent to the curve of any arch.

Models

Models.—Models on which bridge-work is to be constructed but not soldered, are made of plaster or preferably, artificial stone. To permit removal of the caps or crowns from the model during the construction of the bridge, the inside of the caps should be veneered with paraffin to fill in recesses; also the surfaces of posts or tubes to permit them to be easily withdrawn from the model. The exposed outer cervical surfaces of the collars in the impression should be coated with paraffin to prevent the edges of the collars scraping the plaster of the model in reinserting and pushing the scrapings into the grooves into which the edges of the collars fit (Fig. 18). The mere cervical edge of the collar should be left free of the paraffin to permit it to sit closely in the model.



FIG. 18.—W, Paraffin or wax.

Models on which bridge-work is to be formed and soldered should be made of a material as non-shrinkable when heated as is practicable. Plaster and finely ground calcined marble-dust or pulverized silex, mixed in the proportion of 3 parts marble-dust or silex to 1 part plaster for large models, and 3 parts marble-dust or silex to $1\frac{1}{2}$ parts of plaster, for small models, are suitable proportions. Slips of orange-wood, iron pins or small nails may be placed in the impressions of such teeth as are liable to be broken in the removal of the impression from the model. Should fracture occur, a thin mixture of oxyphosphate cement should be used to repair the parts, as this, when thoroughly set, makes them even stronger.

A Hard Surface.—A model of investment material for bridge-work can be given a hard pure plaster surface as follows: First place with a camel's-hair brush in the impression of the teeth and also the surface of the alveolar ridge a film of a very thin mixture of pure plaster or artificial stone, and when it has partly set, fill the remainder of the impression with a mixture of plaster and marble-dust or silex. This to be effective must be skilfully done.

To Harden Plaster Models.—The surface of models of plaster or investing material can be hardened by first drying the plaster by placing it in the rays of the sun in the summer or over a radiator in the winter, thus drying it slowly. It should never be highly heated, as

that makes it chalky. Several coats of very thin sandarac varnish, diluted to about two-thirds the usual consistence, are then applied at intervals to the surface. Immersion of plaster models in melted stearin is also recommended, but for a working model varnish is preferable.

Artificial Stone.—Artificial stone, a calcium silicate compound for the formation of crown- and bridge-work models, is generally being given the preference to other materials, inlay-work excepted. It is hard and durable, and models made of it when worked on are not distorted by friability.

Wax or compound impressions for artificial stone models require no preparation, but plaster impressions should be well varnished. When the varnish is thoroughly dry the impression is soaked in water about five minutes before filling and the water then shaken and blown out, leaving the surface moist. The purpose is to avoid any absorption by the plaster of moisture from the slow-setting artificial stone, which would affect the setting.

In the mixing of artificial stone the powder must be accurately proportioned to the water. The proportion usually given by the various manufacturers is about one-half fluidounce of water to every four and one-half to four and five-eighths oz. avoirdupois, which is equivalent to 80 to 82 dwt. (Troy) of the powder. This makes a thick mix that requires to be thoroughly spatulated. As it cannot be poured it is inserted in deep places with a small stiff brush followed with pieces in the form of cones—proportioned to the size of the space—which can be pressed on with the rubber eraser end of a pencil. The remainder of the impression is then filled with larger pieces until it is full, when a surplus is added. The impression and model are then reversed against the surface of a piece of glass and pressure exerted sufficient to uniformly condense the entire mass. While the model is pressed on it is leveled around the sides of the impression with the spatula.

Another method of mixing artificial stone is, to place in a bowl the required amount of the powder then carefully adding water, a very little at a time and spatulating, bring the mixture to the required consistence.

This artificial stone sets as hard as plaster in from four to six hours. When it is that hard, the model should be trimmed to the desired form, but is preferably left in the impression until the next day.

Artificial stone acquires its maximum hardness in one to two days and maintains it indefinitely.

Articulating Impression or "Bite."—This impression is either taken separately or at the same time with the impression for the model;

the last is the most accurate method. When taken separately it should be done with all the crowns or caps in position in the mouth *previous to the impression* for the model. Wax is more generally used for a separate "bite" than impression compound. Softened wax barely sufficient to cover the parts is pressed over the teeth and crowns to their form, and the antagonizing teeth then occluded. The *finger or cheek* is pressed against the outside of the wax and the patient is requested to press the tongue against it on the inside. The mouth is then opened, the wax chilled with cold water and removed. To secure accuracy it is often necessary to trim the impression of overhanging or superfluous parts and reinsert it a second time. Pieces of tin foil placed over the teeth which antagonize before inserting the wax will prevent their biting through the impression.

Another method is to close the teeth and crowns in the wax or compound so they do not quite occlude, and mount the model and impression on a hinge articulator that will permit teeth and crowns to occlude after the models are mounted and the impression material is removed.

When the model with the crowns has been made, the articulating impression, if taken separately, is placed in position on the model, an articulating model run and both models mounted on an articulator. If the impression of the occluding teeth in the wax is first run and allowed to set it will lessen distortion of the wax in its adjustment on the model.

When impressions for both model and "bite" are to be taken together, plaster mixed moderately thick with the aid of a spoon or rolled in a mass with the fingers is used. The fingers should be previously immersed in water to prevent adhesion of the plaster to them. The stiff plaster is placed around in the mouth, on the crowns, caps and parts to be included in the bridge and the antagonizing teeth then occluded tightly and so held until the plaster sets. The mouth is then opened and the plaster carefully removed. If it breaks in removal, which is usually the case, all the pieces should be preserved, accurately fitted together and secured in position with small pieces of melted adhesive wax. The crowns or caps are generally removed in the impression; but if not, they should be transferred from the mouth to the plaster. The plaster is then varnished and oiled. On the side of the impression containing the crowns, if they are to be removed from the model in the construction of the bridge, an artificial stone model is run, or, if not to be removed, plaster and marble-dust or silex in the proportions already mentioned is used. When set, the model is mounted on an articulator and an articulating model run. Artificial stone is best run in the impressions of the occluding teeth and the rest of the impression

made in plaster and the articulator adjusted. When the materials of which the models were made and mounted are set the plaster impression is removed. (For further details see Part VI, Chapter I.)

Combination Plaster or Artificial Stone and Metal Model.—A method of forming a model in which the parts representing the teeth are of amalgam is as follows: Take an impression in plaster or impression compound. Mix amalgam and pack it into each mold of the teeth or roots and run plaster or artificial stone into the remainder of the impression. The advantage of a model of this kind when gold crowns, attachments or clasps are to be shaped to teeth is obvious.

Another method of forming a combined metal and plaster model much practiced, especially for inlay work, is to first make amalgam or fusible-metal dies with tapering shanks of teeth or roots operated on, then a wax impression and "bite." Run plaster in the "bite" section and when set, fit the dies into the respective impressions in the wax and run the remainder of the impression with plaster or artificial stone, then mount on an articulator. To make a die easy to remove from the model, taper the shank and veneer the surface of the shank with paraffin. A hole made in the base of the model in a line with the end of the shank of a die can be used to introduce an instrument to push the die from position when it is desirable to remove it from the model and use it separately. The reason for running the "bite" model first and allowing it to set is: The wax is less liable to be distorted in the adjustment of the amalgam dies in the wax.

Copper-Amalgam Models.—Models of copper amalgam are also used in the construction of crown-, bridge- and inlay-work.

Copper amalgam is manipulated by gently heating the tablets in a spoon to soften them. The mass is next transferred to the surface of a clean piece of thick paper, and spatulated with a stiff steel spatula until smooth and plastic. It should be carefully and thoroughly packed into the impression and then placed aside to set until the next day before the removal of the impression material.

Copper amalgam gives a hard, smooth model. It can be re-softened and used several times. For this reason is much less expensive to use than the silver-tin amalgams.

CHAPTER V

MOLDS AND DIES

Molds or impressions of single teeth; also cavities in teeth, are taken in metallic tubes, caps or small trays with some one of the impression materials used for the purpose. Stamped seamless caps or tubes can be used; also trays formed from seamless caps by trimming and shaping the caps. Copper plate not heavier than gage No. 32 is generally the most suitable for making tubes, but a much thinner plate may be used when it is required to be passed between the teeth.

Tubes, Caps and Trays

How to make a Tube Quickly.—Take a thin strip of copper plate about gage No. 35, anneal and bend it around the tooth in the mouth or its form on the plaster model. Both ends of the copper at the part lapped are next cut, as shown at A, Fig. 19, and turned over tight and close in the manner seen at B. This fastens the ends which, when trimmed off at C, form a tube. When one end requires extensive trimming to fit the curve of a gum margin, the seam should be soldered with a small piece of either silver or 14-carat gold solder. To take the mold of the end of the root or the whole or part of the natural crown, the end of the tube should be trimmed to the curve of the gingiva and inserted under the free margin. Caps are fitted in a similar manner.



FIG. 19.



FIG. 20.

Trays are used to make the mold or impression of occlusal surfaces or cavities formed in teeth for inlays. A tube or cap when trimmed so that it encompasses only a portion of the crown, as shown in Fig. 20 at A, to take an occlusal surface, or at B for both occlusal and approximal surfaces, is practically a small tray.

The formation of trays and their use in inlay work together with tubes and caps is described, page 235.

Impression for Fusible-Metal Die.—Fill the fitted tube or cap with plaster mixed as for an impression, apply on root or tooth and press to position. In using a tube press the index finger on the open end of the tube and force the surplus plaster downward in the tube. Hold in position until the plaster is set.



FIG. 21.

Moldine.—The application is similar in principle to plaster. The surface of the moldine should be dusted with pulverized soapstone to avoid adhesion.

Casting the Die.—Closely encircle the tube or cap with a strip of paper. Place a rubber band around the paper to secure it, as shown in Fig. 21. Hold the paper and tube with a clamp; melt and pour the fusible metal, moderately cool, and immerse tube and metal in water. This gives a die with a long narrow shank, but which may require trimming at the neck. Plaster molds are generally more accurate than moldine and give better results in casting. To cast fusible metal into a plaster mold or impression under pressure, see page 443.

Impression-compound or gutta-percha used as a mold for fusible metal is not reliable. Such a mold when used should be cooled in ice water and dried before pouring the fusible metal, which should be one that will melt at not higher than 150° F.

Counter-Dies.—A counter-die to a small die of fusible metal is made by indenting a block of lead with a punch about the size of the die and then driving the cast or die into it. Its use in crown-work is described in Part III, page 159.

A counter-die of fusible metal to a fusible metal die may be made either by chilling the male die and oiling or vaselining its surface or coating it with moistened whiting with a brush, and after drying pouring the metal as it cools. (See page 159.)

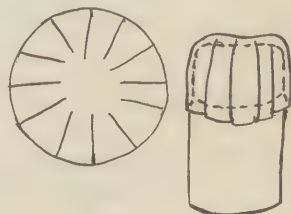


FIG. 22.

Combination Lead and Fusible-Metal Counter-Die.—This is made as follows: Cut two disks of thick sheet pattern tin, such as is used to form patterns for gold plates, or of rolled sheet lead, which is preferable, in sizes that will fully cover that section of the surface of the male die where the metal is to be swaged. Slit the disks from sides to

center, as seen in Fig. 22, which shows disks and die. Place one disk on the die and lap it down on the sides. Press or hammer the occluding surface against a tightly rolled ball of cotton; next slightly vaselin the surface of the tin and fit over it in like manner the other disk. Imbed the die in moldine up to and slightly over the edge of the tin, place around it a metal ring and pour fusible metal. When cold, remove the disk next to the male die. This leaves a slight space for the metal plate which is to be swaged.

Amalgam Dies.—Amalgam is given preference to fusible metal and all other materials to form small dies in crowning and inlay operations, as it is certain to afford sufficient strength with great accuracy of details. Its use is principally confined to the formation of dies in impressions taken with compound. The compound is warmed, the impression taken in a tube, cap or tray, and cooled before removal. The amalgam is then packed in and compressed. If the shank requires

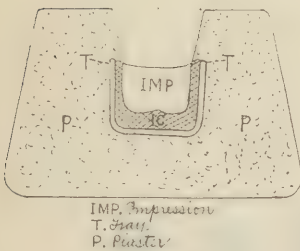


FIG. 23.

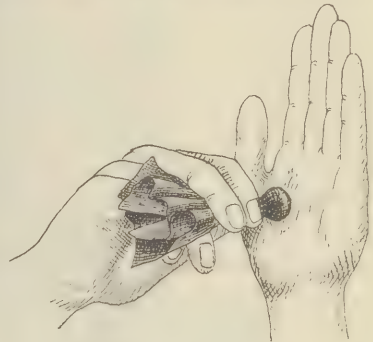


FIG. 24.

lengthening, wind round the tube or cap a very thin strip of copper secured with a string.

If the impression is taken in a tray, detach or cut off the handle, mix plaster to a thick creamy consistence, place a small quantity on a piece of paper and set the back of the tray on its surface, gently pressing the tray down into the plaster so as to form a cup-shaped cavity around the impression. A "Johnson and Johnson" cotton-roll inserted in the orifice of the impression will prevent invasion of plaster as the tray is pressed downward. This furnishes the means of packing and then compressing the amalgam into the impression (Fig. 23 in section).

Amalgam.—The silver-tin amalgams¹ are mostly used instead of copper amalgam for making small dies in molds of impression compound.

The required quantity of the silver-tin alloy is placed in a mortar with a surplus of mercury and ground until the mercury is incorpo-

¹ The Black formula alloys are of this character.

rated, then rolled in a ball, inclosed in a piece of rubber dam, as shown in Fig. 24, and rubbed quickly in the palm of the hand. The amalgam mixture by this method will become very plastic and capable of adaptation to the finished margins of the mold.

A small portion of the amalgam should be first inserted and burnished with a small ball burnisher without pressure to all parts of the impression, then more amalgam added until the surface is entirely covered and the impression is filled gradually but solidly. Compression then exerted on the surface of the amalgam with a round tight-rolled ball of cotton with a vibrating motion will most effectually condense the amalgam and cause surplus mercury present to ooze out. The force can be applied by the finger on the cotton or for small cavities

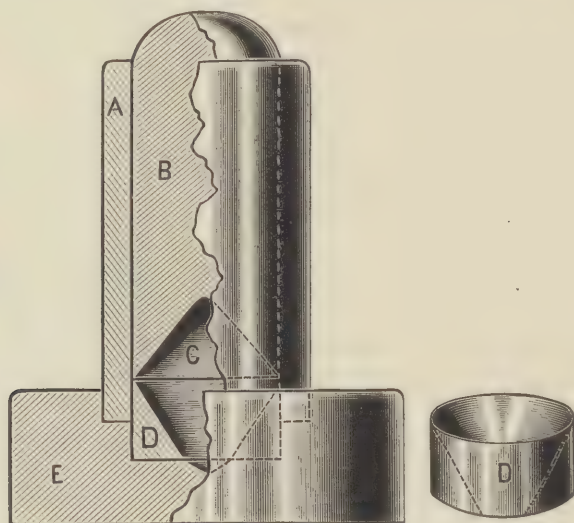


FIG. 25.

the cotton can be wound around the point of an old dull bur or similar instrument.

Amalgam dies should be allowed to stand over night. The impression and die are separated by warming the compound slightly or by immersing the impression and die in warm, but not boiling water. The plaster, metal or paper matrix, when used, should be removed first. The base or shank of the die should be trimmed to the required form when necessary.

The Swager.—This is a tool in which pieces of foil or plate are shaped to the form of a die by compression, and which may be used as a counter-die to a die or *vice versa*. Fig. 25 illustrates a swager partly

in section about three-fourths its actual size. A is the cylinder, B the plunger, C cavity in plunger, D cup, E base. The die is mounted or cast in the cup D, placed in the base E, the cavity C in the plunger B is filled with some compressible substance like moldine, then placed in the cylinder A and the plunger struck down on the die in the cup. The pressure thus exerted by compression of the material in the plunger in the direction of the die gradually conforms the plate to its surface.

To mount a die for swaging a disk of plate or a gold cap in a swager, fill the cup with impression compound and insert the base or shank of the die in it, as shown in Fig. 26. A die for the same purpose may be cast directly in the cup by making an impression or mold of the model

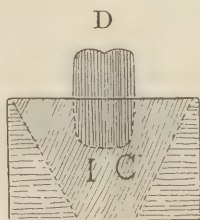


FIG. 26.—IC, Impression Compound.

in the center of the surface of a flat piece of moldine, placing the cup over it, as shown in section in Fig. 27, and filling the cup through the aperture with the fusible metal.

An intaglio die is made with a cusp button by placing the cup over it and then filling the cup with fusible metal (Fig. 28).

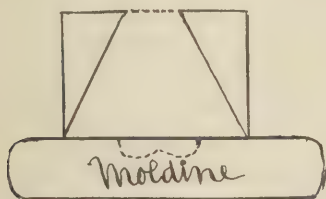


FIG. 27.

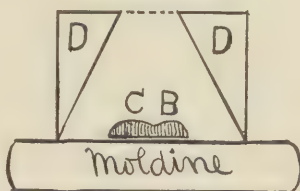


FIG. 28.—D, Cup; CB, cusp button.

Swaging.—Cut the plate that is to form the matrix to the desired shape and with pressure by means of spunk or cotton approximately adapt it to the metal model and cover it with a rubber disk. Place in the cylinder a mass of moldine about three-quarters of an inch thick. Insert in the top of the cylinder the steel plunger and strike it lightly with a mallet. Remove cup and model from the cylinder, examine and burnish out any wrinkles or folds and reswage.

CHAPTER VI

INVESTMENTS AND SOLDERING

Materials Principally Used for Investments.—Calcined marble-dust finely pulverized, silex, common white sand or ground asbestos, combined in proper proportions with plaster, are principally used to form investing materials for crown and bridge-work, as they give a small percentage of contraction.

Small Investments.—For small investments like single crowns, the proportions generally used are 2 parts finely pulverized calcined marble-dust or silex to 1 part plaster.

Large Investments.—For large investments, including pieces of bridge-work, $1\frac{1}{2}$ part finely pulverized calcined marble-dust or silex, 1 part sand and 1 part plaster. When used in this proportion the sand prevents the contraction that takes place in large masses of investing material composed entirely of fine marble-dust, when subjected to great heat for considerable time. The fine marble-dust in combination with the plaster is more suitable to fill in interstices and the inside of caps than the sand alone.

Asbestos.—Asbestos may be substituted for sand, the coarse being used in large investments. Trimming must be carefully done if coarse asbestos is used as it is not easily cut, and displacement of the investment material exposing some parts of the work is liable to occur.

Method of Investing.—The ingredients should first be thoroughly mixed in the dry state. Water is then added in quantity sufficient to make a thick batter-like consistence. The thicker the mix can be made and be practical, the better. The mixture should be rapidly and thoroughly spatulated. Potassium sulfate may be used in very small proportion to cause the mixture to set quickly.

To invest a model made of investing material on which bridge-work is being constructed the model should be trimmed as small as is safe without risk of fracture. It should then be soaked in water while the investing material is being mixed. The reduction of the model is for the purpose of securing the largest possible proportion of refractory

investing material in the investment to that of the model; and its immersion in water is to prevent absorption of water from the investing material and to obtain a better adhesion of the investment to the model.

In bridge-work, especially in cases of any great size, a loop of iron wire should encircle the piece in the investment. (See page 290.)

Preparation of Investment for Soldering.—When it is desirable to remove the wax connecting sections of a crown or bridge in an investment before heating, it should be done by pouring boiling water on the parts. The removal of wax with an instrument is not advisable, as parts delicately held in position are liable to become displaced. The removal of the wax exposes the metallic portions of the work to be soldered. All surplus and especially overhanging investing material should be removed, but parts already soldered should be left covered.

The metallic parts to be soldered should be exposed as much as possible to the direct flame of the blowpipe, as the greater their *depression in the investment*, the more difficulty will be experienced in guiding and controlling the solder *at a particular point* with the blowpipe.

Care should be taken that all parts of the porcelain teeth are covered and all crevices between them filled with the investment material to prevent the invasion of borax or solder, either of which is very liable to cause their fracture. The filling-in with gold foil or Corona gold of small open seams between sections of metal to be united facilitates their union in soldering. The filling-in of large spaces under caps or tips to porcelain facings can also be much facilitated by packing into the spaces pellets of foil or Corona gold or by placing in them pieces of plate or wire. A moderate application of flux may now be made to the deeply invested parts, as directed under article on "Flux," page 12.

Many prefer to trim the investment and let the wax burn out as the investment is heated. This is done when fluxed wax is used and the benefit of the flux is to be obtained. The objection to the burning-out of wax is that owing to the resultant debris pits are more liable to be found afterward in the solder.

Heating the Investment.—In soldering crowns and bridge-work or sections of it containing porcelain facings, the investment should be uniformly, gradually and thoroughly heated over a Bunsen flame until the bottom of the investment assumes a dull red tint.

An investment when heated suddenly by being placed over a Bunsen flame is liable to be fractured by the sudden expansion of steam generated in the investment material. This will not occur if the investment *has previously been immersed in, or washed with boiling water.*

A piece of heavy iron wire, about gage No. 8, bent in the form of a scroll, as shown in Fig. 29, or a piece of sheet iron perforated with large holes placed across the top of a spider fitted to the burner, forms a good support. When heated, the investment should be removed to a soldering block.

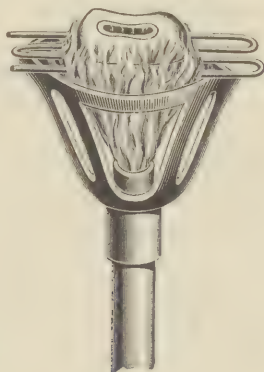


FIG. 29.

Soldering Blocks.—A large round piece of charcoal about 5 inches in diameter and 6 inches long, with a little concavity cut or burned out on one end, and with a thin covering of plaster on the sides to prevent soiling the hands, furnishes a good soldering support and one that will

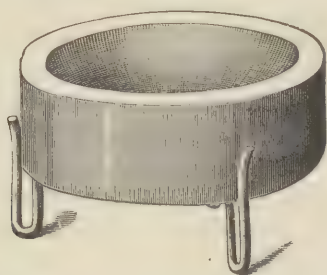


FIG. 30.

retain the heat. Seams or cracks in the charcoal should be filled in with a mixture of sand or asbestos and plaster, to retard the burning out of the block. Two or three iron nails inserted in the concavity of the block, a little to one side of the center, are useful at times to prop up an investment. Manufactured soldering blocks, such as are shown in Fig. 30, are preferred by most practitioners to those of charcoal.

A Serviceable and Lasting Soldering Block.—Take a porcelain bowl about six inches across the open end, vaselin the inside surface and place over it a half-inch coating of pure plaster. When set, remove the plaster coating, which may be facilitated by slightly warming the bowl. Next take equal proportions of coarsely pulverized charcoal, sand, asbestos and plaster, a sufficient quantity to fill the newly formed plaster bowl, and mix together thoroughly with water. Place the mixture in the plaster cast of the bowl, slightly depress the center and insert in it four or five iron nails to tilt the investment during soldering and prevent it from sliding off the block. (In section, in miniature, Fig. 31.) Place bowl and contents aside in a dry place to set and slowly dry out, which will take some time. Before using the first time, thoroughly heat the center of the surface of the block with the blowpipe flame.

This will prove a very serviceable and durable soldering block and one that will hold the heat next to one entirely of charcoal.

The Structure of Flame

A knowledge of the structure of flame will assist in its use in soldering.

Fig. 32 shows a candle flame. A, central cone, consisting of unburned gases, termed non-luminous cone. B, yellow cone of partial combustion, which emits the light, termed the luminous cone. C, cone of nearly or complete combustion, which emits only a faint light and is termed the semi-luminous cone. D, blue section of the base, extending only a short distance upon the sides.

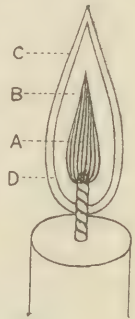


FIG. 32.

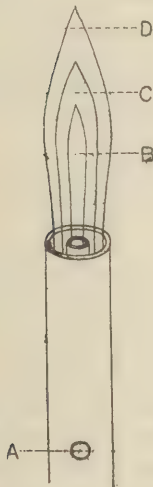


FIG. 33.

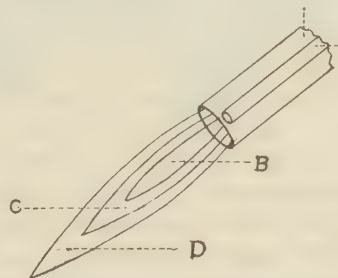


FIG. 34.—B, Central cone; C, deoxidizing flame; D, oxidizing flame.

The Bunsen Flame.—The Bunsen flame consists of a gas flame, into the central cone of which oxygen is carried by draft through an aperture made in the base of the burner, as shown in Fig. 33. The air drawn by the draft of the flame enters the hole A and is carried into the central cone B, where the oxygen it contains causes complete combustion. C is the deoxidizing or reducing flame; D the oxidizing.

The Blowpipe Flame.—The blowpipe flame differs from the Bunsen flame in that the air is forced into the central cone of the flame through a central tube from a bellows or air-pressure tank, Fig. 34. The heat is intensified by the complete combustion effected in the Bunsen and blowpipe flames.

As shown in Figs. 33 and 34, the deoxidizing flame is the portion to be used for soldering, as it cuts off the oxygen from the air and prevents oxidization of the metal. When an oxidized sheet of copper is held in this part of either the Bunsen or blowpipe flame, its surface is brightened in the area of the flame. This is caused by the carbon, oxygen and copper uniting and forming carbonic dioxide, CO_2 , which is passed off. The use of the extremity of either of these flames should be avoided as it naturally oxidizes the surface of the metal.

Blowpipe and Method of Using it.—A hand gas-blowpipe (Fig. 35, the Bower) operated by a foot-bellows of medium size and so constructed as to be under perfect control, especially respecting diminution of the flame to a very small point, makes a satisfactory apparatus. Compressed air is much used at present in preference to the bellows. When heated and ready for soldering, place the investment in the center of the soldering block, using large tweezers for this purpose. The full flame of the blowpipe should be directed at first under and around the sides of the investment, which is slightly tipped or propped up at one side for the purpose. In this manner the investment is uniformly heated to a point sufficient to melt the solder without pointing the flame.

When the heat of the surface of a piece of metal is lower than that required to fuse the applied solder, the solder if fused on it will ball up and roll off. The tendency of melted solder is to flow to the hottest point. It is also affected by gravitation. By the application with the blowpipe of a greater degree of heat under the investment than on the top, the solder can be drawn down into the deeply invested parts, but if after flowing solder to and in these parts a heat is still maintained sufficient to keep the solder in a molten condition, and a slightly greater heat is applied to the surface section of the investment, the solder is liable to be drawn upward. In the soldering of a collar crown in this manner, the solder that has been drawn down between the

porcelain facing and cap and around the collar on a line with the porcelain is liable to be largely drawn backward and absorbed in the final soldering of the backing and contouring of the crown. Therefore in soldering the work, especially crowns and pontics with porcelain facings, these points should be borne in mind. When certain parts of

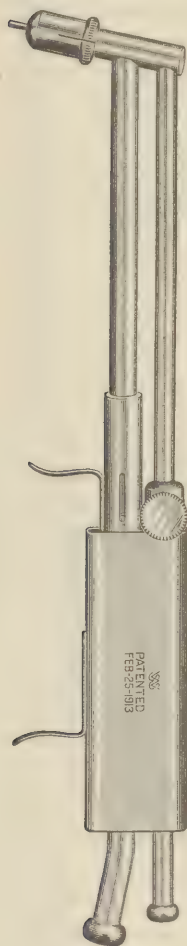


FIG. 35.

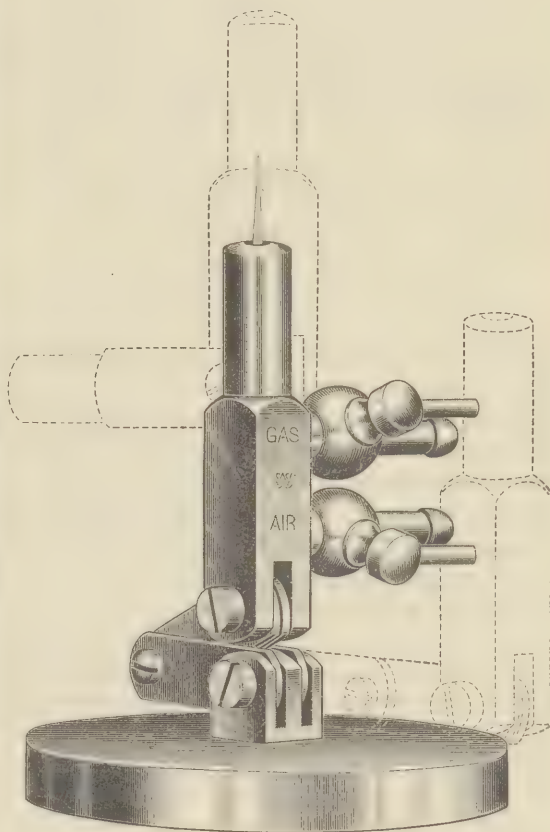


FIG. 36.

the work have been united and generally filled in with the solder under the effect of properly applied and moderate sized flame, the flame may then be reduced in volume and pointed for a moment to guide the solder to and better shape it at some special point. Proper position

for the investment and correct application of the heat in soldering aid greatly in accomplishing the desired result.

The Grünberg Blowpipe.—This form stands on a circular base. The several joints allow the flame to be pointed in any direction the user desires (Fig. 36).

Preparation, Application and Fusing of Solder.—The solder should be cut in small square and oblong pieces and placed within convenient reach of the points of the tweezers. The pieces may be coated with borax finely ground in water or with liquid flux, and should be allowed to dry before application to the work. When the investment on the soldering block has been brought to a dull red heat, or approaching it, with the blowpipe, a little solder should be applied at the point where the soldering is to be begun.

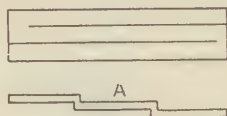


FIG. 37.

The portion placed in the investment is first melted and flowed into the interstices of the work, using the large flame of the blowpipe under and around the investment and alternately a moderately sized flame at the part being soldered, using the deoxidizing portion of the flame. More solder is then added by degrees and, as the parts become filled, by the use of a smaller flame applied directly to the part and the judicious use at times of a small-pointed flame and the gradual addition of more solder the parts can be given the desired form. Solder is also applied in strip form. The solder is cut in a long narrow strip and one end is held while the other, which has been fluxed, is applied to the part being soldered. How to slit and form the ordinary form of solder into a strip is indicated in Fig. 37. The slit piece of solder bent out is shown in figure A.

In large pieces of bridge-work with considerable curve it will be found necessary to solder a portion at a time. This is best done by placing each portion as it is to be soldered in the deepest part of the concavity of the soldering-block and, when soldered, slightly cooling and



FIG. 38.

changing the position of the investment, as gravity tends to carry the melted solder to the lowest point.

A pair of solder-tweezers with a long reach and small curved points, as illustrated in Fig. 38, should be used to pick up and place the small pieces of solder.

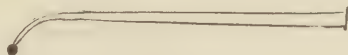


FIG. 39.

Solder-pointer.—A small pointed instrument with a handle at least 6 inches long, termed a solder-pointer, is useful to stir up, spread and draw the solder to a desired point. The point of the instrument should preferably be made of platinum instead of steel. The Alloy termed "Platinoid"¹ can also be used.

When desirable to melt a very small piece of solder at a point where it is difficult to retain and fuse it in position, flux and melt the desired quantity of solder in a globule on the block, and touch it with the extreme tip of the "pointer." The globule will adhere to the "pointer" in the form of a little ball as shown in Fig. 39. Heat the special part to be soldered to the fusing heat of the solder and apply the globule with the "pointer." When the soldering is completed, an investment that contains porcelain facings should be inverted on the soldering block and allowed to cool slowly. This tempers the porcelain and prevents checking.

Soldering Practice Pontics for Students.—The use of practice pontics, crowns and bridges affords an inexpensive method of teaching students to solder. It consists in cutting and shaping small pieces of pure silver, German silver or Platinoid to represent the metallic parts of



FIG. 40.



FIG. 41.

a crown or bridge, then waxing the parts together, investing and soldering them with silver solder, as illustrated in Fig. 40 (slightly enlarged). A shows a piece of the metal bent to represent the backing of a porcelain facing and the floor of the cap of a cuspid crown; B is a side view of the same to indicate the angle at which the metal should be bent; C, the position of the wax, the dotted line indicating the

¹ An alloy of nickel.

surface of the wax; D, a ring of the plate to represent a molar crown; E is a side view of a piece of plate bent to represent the backing and cusp cap of a dummy bicuspid pontic; F, a lingual view of the same; G, the line of the wax.

Fig. 41 is a side view partly in section of a dummy cuspid crown invested and ready for soldering practice.

Fig. 42 represents a dummy bridge ready to solder, consisting of a cuspid and a molar crown as abutments supporting the bicuspid.

Practicing soldering on these dummies involves only a trifling expense, and the student will readily acquire the technique and quickly become proficient without waiting for practical cases.

Open-Flame Soldering.—Open-flame soldering is done in a Bunsen (gas) flame and is the method used for soldering small sections of the

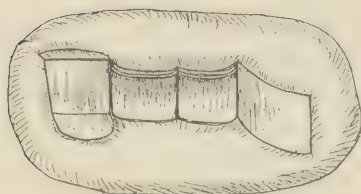


FIG. 42.

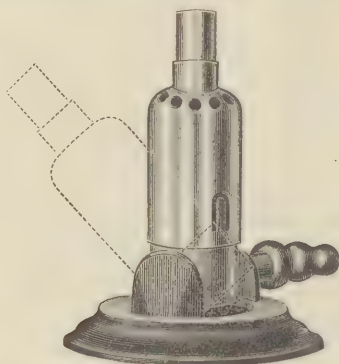


FIG. 43.

work such as the seams and floors of collars. A Bunsen burner of the form illustrated in Fig. 43 (one-half size) is most convenient for general use, as it permits the supply of air to the center of the flame to be regulated.

The metal is held by a clamp and heated in the flame. (See part III, Chapter V.) The heat should be applied gradually, with the metal first held above the flame and then slowly brought downward into it to a point just above the deoxidizing or reducing flame, and held there as briefly or as long as is necessary to effect the desired fusion.

Rouge in a very thin paste or a mixture of one part marble-dust and two parts whiting applied on the inner or cavo-surface of a collar or cap will obstruct intrusion of the solder. The marble-dust and whiting are easily washed out but are not as reliable a preventive as the rouge. The heat should be applied slowly at first to permit evaporation of moisture.

Union by Sweating.—This consists in uniting the edges or surfaces of two pieces of metal by heating them so closely to the fusing-point that union takes place without melting the main body of the metal. The process is much used to unite the seams of collars. The metal is first boiled in acid and washed; the clean edges are brought together, as in the case of a collar, so that they lap slightly, touching at every point. The edges are then fluxed and the collar is placed on a charcoal block. The whole of the collar is first brought to a bright red and then with a small pointed flame gently passed over the edges to be united the gold is fused at that point and no other. This is facilitated by applying the flux only to the parts to be united, which by preventing oxidation causes the surfaces to fuse together before the main body of the metal melts.

Another method is to hold the collar with a soldering clamp, seam downward, in a Bunsen flame until it unites, when it should be instantly withdrawn (Fig. 44).



FIG. 44.

Soldering with a Compound Blowpipe Flame.—Platinum solder requires a compound blowpipe flame to melt it. This can be improvised by connecting the air tube of an ordinary gas blowpipe to that of a cylinder of nitrous oxid gas. The flame of the blowpipe should be reduced to a very small jet and the volume of the nitrous oxid turned on very slowly until an amount of pressure is reached sufficient to point the flame and effect perfect combustion. A small compound blowpipe of the style illustrated in Fig. 45 is suitable for soldering and general use,¹ but the fusing of platinum solder may be effected quite satisfactorily with the ordinary blowpipe, using nitrous oxid instead of air as first described.

Annealing.—Annealing gold is done either with the open flame, the blowpipe, or in the muffle of a furnace. In the open flame by holding the piece of plate with a clamp in the deoxidizing part of the flame—until as high a degree of heat is reached as the character or carat of the plate will permit without melting. Pure gold will permit a light yellow heat; 18- or 22-carat plate from a dull to a bright red. Large pieces of gold require to be laid on a soldering block and heated with a blowpipe.

Platinum is best annealed in an alcohol flame or in the muffle of an electric furnace. It requires to be brought to a white heat and kept

¹ The I.e Cron blowpipe.

there for a short time. In a gas flame platinum suffers deterioration by the formation of carbide of platinum, which oxidizing later is liable to blister the metal.

The best results in annealing are accomplished by allowing the metal to cool slowly, although much time is often gained by immersing

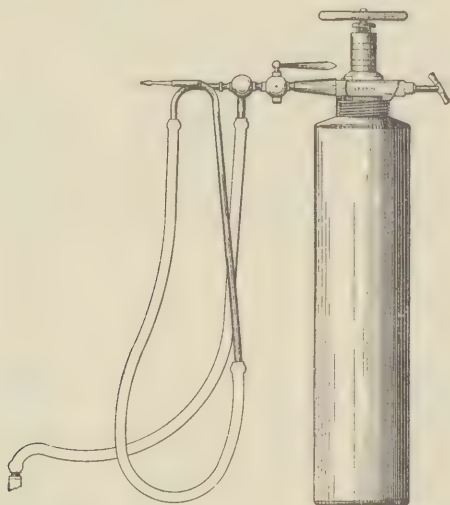


FIG. 45.

in water. This, however, should not be practiced with ingots of gold or silver just melted and poured.

Each time metal is bent, burnished, hammered, drawn or rolled, its softness, flexibility and ductility are impaired, but they are quickly restored by annealing. This fact should be always borne in mind in the manipulation of metal in the construction of all forms of work.

CHAPTER VII

THE CASTING PROCESS

The introduction in gold casting of the process of compression in the construction of dental appliances has simplified and improved the character of many operations. Because it has been comparatively recently introduced, like other innovations in dentistry, the sphere of its usefulness and whether it is to be preferred to other and longer established methods are not as yet definitely determined. Practical experience in time will alone decide. Many practitioners, for instance, who at first used the method extensively for plates, crowns and bridges have already gone back to swaged plates and soldering operations. In the formation of gold inlays and small pieces of bridge-work requiring accuracy in form and continuity of structure, the casting process has decided advantages. But in the casting of large pieces the varying expansion and contraction of metal, wax and mold are difficult to entirely control; and the cast plate and clasp lack the resiliency and compression of the molecules present in rolled gold plate or drawn wire attributable to the process by which they are made. Improvements in materials, and of details in methods of conducting operations may—indeed already are overcoming some of the objections to casting above outlined.

The casting of gold from wax models requires great accuracy and care in all the details of the operation, as well as suitable materials and appurtenances.

Inlay Wax.—Inlay wax for models is composed principally of wax and paraffin. Manufactured inlay waxes¹ are supplied in sticks and in cones or forms suitable for use in cavities by casting the wax in molds to regulate molecular tension.

Formation of the Inlay Wax Model.—The wax model is made either in the mouth or on an anatomically articulated model. The former is termed the *Direct Method* and the latter the *Indirect Method*.

¹ Manufactured inlay wax is generally used for inlay and other casting operations. The exact composition of the different inlay waxes is kept secret by those manufacturing them. Light-colored pink hard sheet wax is often preferred by many in forming casting models, especially of saddles in crown- and bridge-work construction, as it may often be more conveniently applied and manipulated than the regular inlay wax.

When a casting is to form part of a crown or bridge, the shaping of the wax model is generally done on the model on which the work is being constructed.

Wax to form a model for casting should be softened uniformly in warm water heated to a temperature comfortable to the fingers, which ranges from 120° F. to 135° F. It should be merely pressed to shape, but not rolled or balled with the fingers. The wax is first placed in position and then pressed with the finger, the pressure being so directed that the wax shall reach all parts to be reproduced, especially in the case of cavity walls and margins. The wax is then trimmed *to the contour of the tooth* with a small spatula. Every detail of form and finish desired in the gold must be effected in the wax. The wax model should be chilled before removal.

For further details in inlay work see page 216.

Adhesion of the wax to the tooth structure in the mouth is prevented by the saliva and on a plaster model by wetting the part to which the wax is applied. When oil or glycerin is used it should be only the smallest possible quantity. The warmth of the mouth prevents rapid hardening of the wax while it is being shaped. The same advantage may be obtained for a wax model in the indirect method by placing the entire case in tepid water for a short time at intervals.

Investment.—The Taggart investment flask consists of a ring and cap termed a crucible former, as shown in section at A in Fig. 46

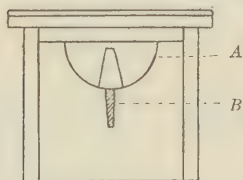


FIG. 46.—A, Crucible former; B, sprue wire.

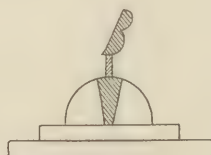


FIG. 47.

(three-fourths size) with the sprue wire B in position. The sprue wire forms the entrance to the mold of the wax.

To invest the wax model remove the sprue wire from the cap of the flask, heat the point and veneer it with a particle of sticky wax, cool slightly and introduce the point into the outer surface of the wax model at the point of greatest bulk in the wax and as far as possible from all margins, and at an angle that will offer the most direct flow for the melted gold into the mold of the wax. This is shown in Fig. 47 (three-fourths size), which illustrates the model of an occlusal surface of a crown mounted ready to receive the investment. It is

always best to have the line of any part of the wax model *below the point of entrance* of the sprue wire into the wax so the molten gold on entering the mold will not be required to take an upward angle. A very small sprue should be used for extremely small castings. For such cases it is an advantage to fill the hole in the crucible former with wax, using a common pin with the head cut off for the sprue. The gage of a sprue wire for larger castings varies according to their size up to 15 gage.

The surface of the wax model should be cleansed before investment. This is especially required when oil has been used to prevent adhesion of the wax, as an oiled surface interferes with accuracy of investment. Spraying the surface of the wax with a mixture of equal parts alcohol and ether will effectively cleanse the wax. Glycerin being readily soluble in water is easily removed.

Investment Material.

Specially prepared investment material is used

to invest in casting work.¹ The material and water should be properly proportioned by weight and measure. Fig. 48 shows the Taggart device for measuring the proportion of water and powder. It is

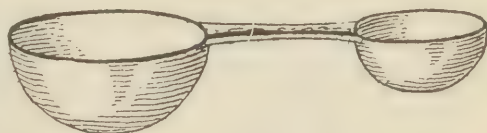


FIG. 48.

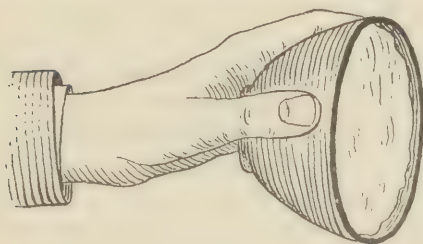


FIG. 49.

preferable to have the mixture a trifle thick rather than thin. A china bowl for mixing is preferable to a rubber one, as a minute particle of rubber could be scraped off, and freedom from contamination is necessary. The material should be swiftly spatulated around the sides for at least a minute,

occasionally jarring the bowl on the bench to remove air and insure a thorough mix (Fig. 49). A mixing apparatus has been introduced, but rapid continued manipulation with a spatula is effective.

First spray or wash the surface of the wax with alcohol and ether, half and half, to cleanse it especially of oil, then dip in water. Care-

¹ Prepared investment compounds variously contain plaster, graphite, whiting, silica, etc. The silica acts as a base, the graphite or whiting to fill interstices and the plaster as a binder. Mr. L. J. Weinstein gives his formula as plaster 29 parts, fine silex 71 parts, to be mixed in the proportion of 21 dw. (troy), of the powder to one-half fluidounce of water.

fully place a thin layer of the investment on the wax model with a small camel's-hair brush, then larger portions until it is covered, as shown in Fig. 50. This is to avoid air-bubbles, which would fill with gold. Set the ring on the cap and carefully pour the remainder of the investment. Do not jar the flask to remove air-bubbles, for if they are present underneath the wax model, they are liable to settle against its surface as they are forced upward. Take time, as the setting will not interfere with the investing for several minutes. Do not attempt to fill more than one investment at a time. Allow the investment to harden for at least twenty minutes but not for an indefinite time. If left until the next day the mold before heating should be placed in water until saturated,

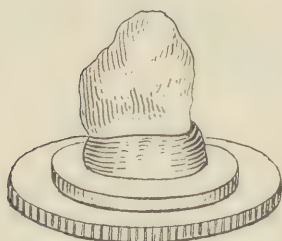


FIG. 50.

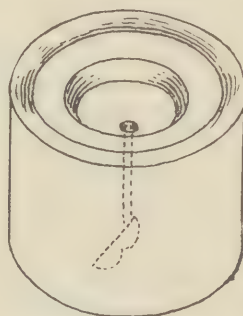


FIG. 51.

to compensate for the moisture that has dried out. When thoroughly set, remove the surplus investment, warm the flask slightly and remove the crucible former and sprue wire, also any loose particles of investment material. The case is then ready to be heated for casting, as shown in Fig. 51.

Heating the Investment.—This is done so as to get rid of the wax model in a manner that will cause the least possible change in the shape or dimensions of the matrix, and leave the investment in the best form to cast into. The crucible former is removed and the flask is placed on a piece of sheet iron on a spider over a Bunsen flame. First the moisture of the investment should be evaporated slowly at a temperature that will melt the wax but not boil it. As the moisture is evaporated, the investment gradually absorbs the wax, leaving a clean matrix of the model. This takes twenty-five to thirty minutes, the heat being brought slowly up to 150° F., then gradually increased as the wax is absorbed. The heat is increased to a point that will volatilize and burn out the wax and carbonize any residue, which is about 350° F., and then to 400° F., allowing about fifteen minutes for

the operation. In the last few minutes the flask may be placed on its side directly over the Bunsen flame. The investment is then ready for the casting. Conducted in the manner outlined, the injurious effect of sudden or excessive heat is avoided.

To accurately define the heat applied to the flask, invest an ordinary vulcanizer thermometer with asbestos and plaster in a brass ring and place it alongside the flask. Gas and electric ovens with a thermometer have been devised for heating flasks.

The wax in the mold at the time it is burned out leaves a film or binder on the wall of the matrix that imparts to it a certain amount of firmness and a comparatively unyielding surface. This results in a smooth as well as a bright casting by carbonization of the wax film and exclusion of the oxygen of the air. As this film is greatly impaired by cooling and reheating the flask, *the casting should be done immediately after the wax is burned out.*

Removal of Wax from a Casting Flask with Boiling Water.—To follow this method let the investment set for one hour, then place the flask in boiling water, crucible end up for 15 minutes. Remove the flask, place on heater and immediately run the heat up to 320° F. then to about 360° F., consuming in time about one hour.

Whether a hot or a cool flask is preferable to cast in is disputed. The question is in a measure answered by the fact that the crucible section of the flask has to be heated to the fusing point of the gold in the operation of casting, except when a centrifugal machine is used.

Gold.—Pure gold slightly alloyed, 2 to 3 per cent. copper, is generally the best for inlays, platinized gold when toughness and hardness are required, and coin or 22-carat gold for special parts of crown- or bridge-work. (See page 8.) An ingot not over three dwts. more than is required for the casting should be placed in the crucible. There is no waste of the surplus.

Expansion and Contraction of Materials and Metals.—The expansion and contraction of materials and metals when heated and cooled are difficult to determine and cannot be entirely overcome. Therefore all metallic castings, though approximately correct, are *not absolutely so*. Inlays or other gold castings are either expanded or contracted in part or all of their form. This is especially attributable to the expansion and contraction of the wax; also to the contraction of the investment material that forms the mold and that of the gold. It is also caused by the excessive expansion of the brass ring of the flask in large castings.

Heat expands a wax model as it is molded to a given form, which contracts as it cools. Investment material of which a casting mold is

made contracts from loss of moisture. This contraction is largely counteracted by the expansion and non-shrinking properties of the other ingredients. Gold expands when fused and contracts when it cools (.001451 inch).

To meet these conditions the wax model can be invested while it is warm, or if left to cool, its temperature can be raised by immersing it in water of a temperature of 90° F. The temperature of the investment should also be brought to 90° F. by mixing with water of 110° F. The expansion of the wax and some expansion also effected by the use of an investment containing a proper proportion of silex will closely compensate for the contraction of the gold.

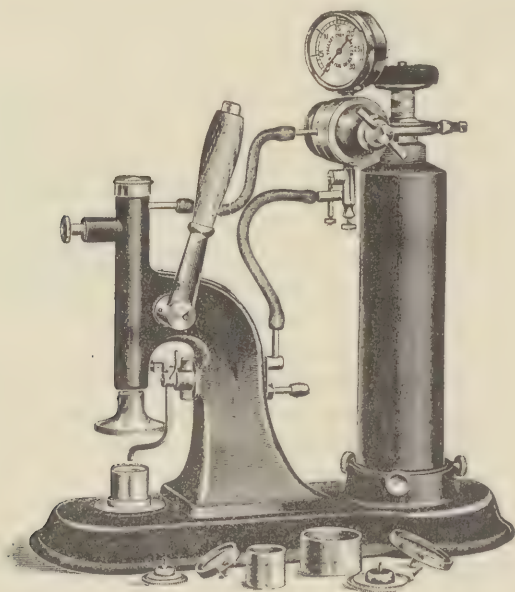


FIG. 52.

Casting Machines.—Various forms of machines are in use to perform the operation of casting. The Taggart, Fig. 52, the style first introduced, melts the gold with the carbo-oxyhydrogen blowpipe and forces it into the mold by pressure of the same gas. It has two dial indicators, one of which registers the pressure of the gas in the cylinder and the other the pressure under which it is released; a pressure valve which can be set for the pressure desired; a carbo-oxyhydrogen blowpipe; a compressing lever and a mold flask holder.

Figure 53 shows the Burns casting machine. This machine uses compressed air. It is provided with an air valve to regulate the pressure and a gage to indicate the amount applied.

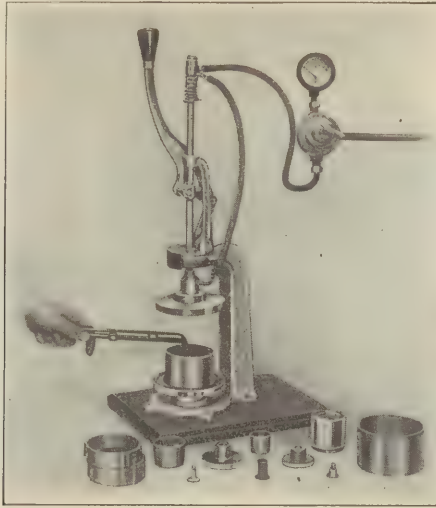


FIG. 53.

The Monson.—This is a centrifugal machine, shown in Fig. 54. The inlay flask is placed in the extremity of the arm with the crucible in front of it. When the gold ingot is fused turning the handle of the

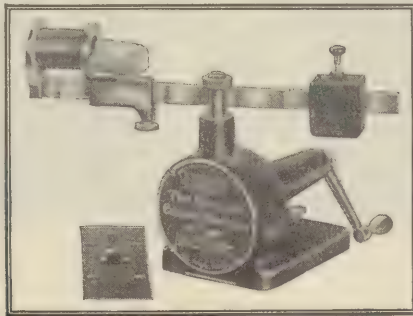


FIG. 54.

machine imparts rotary motion and centrifugal force to the arm, which moves in a horizontal plane that sends the molten gold from the crucible into the inlay flask.

The Gardner.—The feature of this machine is the combination of the crucible and inlay flask as one unit. At A Fig. 55 is shown its formation and at B the machine in the operation of casting. The centrifugal force is applied to the arm, which is revolved horizontally by an elliptical spring. The pressure in casting is regulated by the number of half-turns given the spring.

A



B

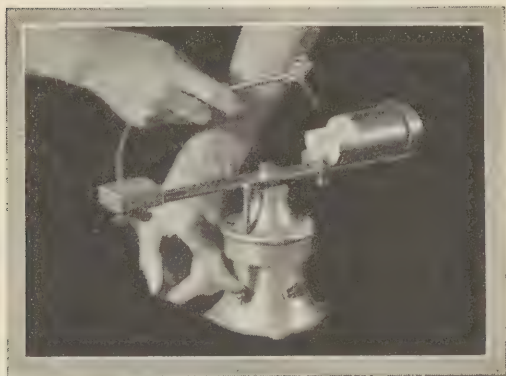


FIG. 55.

Casting machines operated by the compression method are extensively used. The gold when fused in the crucible is compressed with a wet asbestos packing that extends over the gold and flask disk. The steam which is instantly generated forces the molten metal into the mold.

The Sobrig, shown in Fig. 56, and the Seymour, are of this type.

The S. S. White swager, (Fig. 25) with a specially designed casting outfit, is also used for the purpose.

Casting Process.—In the operation of casting, the gold is placed in the crucible cavity of the mold and brought to a white heat, so that it appears to boil. The heat is then lessened momentarily sufficiently to allow the appearance of boiling to cease and the gold is ready to enter the mold. The blowpipe is instantly laid aside and the pressure applied and retained. A pinch of pulverized vitrified borax may be sprinkled over the gold or its surface painted with liquid flux before it is melted.

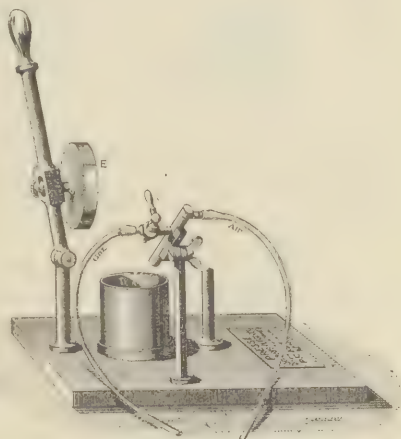


FIG. 56.

In the use of a carbo-oxyhydrogen blowpipe a small intense flame is directed on the gold, which melts it quicker than an ordinary gas flame and without affecting the mold proportionally. As pressure is applied on the molten gold, the residual air is driven off into and through the minute pores of the investment. Superheating the gold, or excessive pressure in casting should be avoided. Superheated gold is liable to unite with the investment and excessive pressure tends to expand or distort the investment matrix.

In the use of the carbo-oxyhydrogen blowpipe excessive heating is liable to occur, owing to the intense power of the flame. Excessive pressure can be avoided with the Taggart, as it can be controlled with the pressure valve. The pressure required for casting is from eight to ten pounds for large or moderate-sized castings and from ten to thirteen pounds for small ones. The smaller the casting the greater the pressure required.

The casting should be allowed to cool slowly and never be plunged into cold water. When cool it is removed from the flask and scrubbed with a stiff brush. Cut the casting from the ingot, heat to a dull red, drop into a strong solution of sulphuric acid or pure nitric acid, or both, then wash and place in hydrofluoric acid for a few hours or over night. This gives a clean surface to the gold.

Large Castings.—Large castings and moderately small flat ones require one or more extensions of the sprue to better enable the molten

gold to instantly reach all parts. Fig. 57 shows the model for a small plate so mounted. These extensions from the sprue are made of wax rolled to about the size of the sprue wire. The center of the roll is attached to the sprue wire and the ends of the wax placed in position on the wax model.

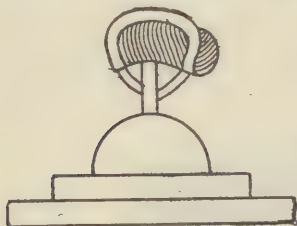
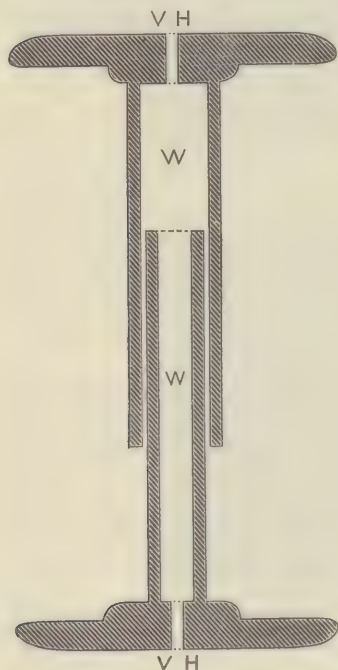


FIG. 57.

syringe moderately heated and pressure exerted on the end opposite to the one from which the required wax sprue is to be ejected (Fig. 58 in section).

FIG. 58.—W, Reservoir of wax;
VH, vent holes.

The Schweitzer Wax Sprue Former.—

In construction this is a telescoping syringe with a small hole at each end by which two sizes of wax sprues are quickly and easily formed. To operate the syringe the inside is charged with inlay wax, the

Exit Vent.¹—In large castings, a vent that will allow free escape of vapor from the cavity of the mold as the molten metal is injected, facilitates and extends its distribution. Such a vent is best placed in the investment above the line of the cavity of the mold. The vent is made by covering an annealed piece of copper or iron wire about gage No. 33, with a veneer of wax, then passing it through a hole in the upper part of the flask and bringing it down to the wax model, as shown

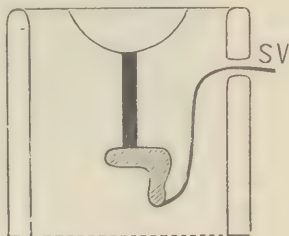


FIG. 59.—SV, Sprue vent.

in Fig. 59 (a Taggart flask); or, the waxed wire may be extended through the surface of the investment close to the rim of the flask down to the wax model.

¹ Method devised by Dr. H. Schweitzer.

Large Wax Models.—To form wax saddle or plate models for casting, mark on the plaster model the outline of the plate the same as for a swaging operation.

To harden the surface of the plaster, slightly dry the model and give the surface one or two coats of shellac varnish well diluted with alcohol so that it will soak into the plaster, and allow it to dry. Next apply one or two coats of thin sandarac varnish and set the model aside until thoroughly dry. The shellac acts as a binder and the sandarac glosses the surface. Vaseline the surface with a piece of cotton and thoroughly wipe it off. This leaves a smooth and slippery but not a greasy surface

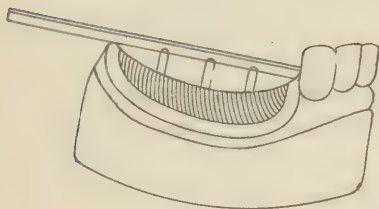


FIG. 60.

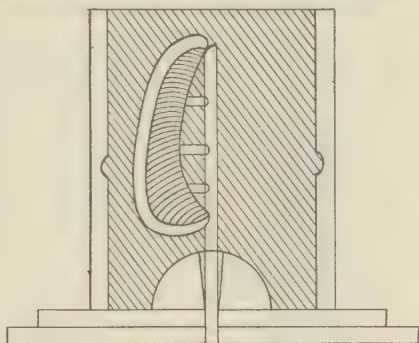


FIG. 61.

to the model. During the formation of the wax model or pattern, if a lubricant is desired, the use of glycerin is preferable to oil or vaselin as glycerin is miscible in water and consequently is easily washed off the surface of the wax.

For the casting model use thin sheet wax, such as is prepared and sold for the purpose, or a piece of semi-transparent pinkish wax now used for base-plates. Soften the wax in tepid water; if too thick roll it out to the gage desired to cast the plate, transfer it to the plaster model and adapt the wax perfectly to its surface. Trim the surface to the required size as marked on the model and place a bead around the edge, if one is desired (Fig. 60).

The sprue wire should be at least 15 gage and be placed in position before removal from the model. It should form a canal in the investment through which the melted metal can flow directly and through short wax sprue branches to all parts of the mold. For casting a large saddle the sprue wire should be placed so as to allow the wax saddle to be set in the flask in a line perpendicular to the cavity of the crucible former, as shown in section in Fig. 61. When set as illustrated

the sprue wire may be made of a piece of iron wire about gage No. 14. In this way a reliable viaduct is formed to carry the gold to the smaller channels. An extra long flask is used to furnish space. The end of the sprue wire is to be fastened in the hole in the crucible former with hard wax. The wax model is next thoroughly chilled and carefully removed without distortion of the edges. If there is any apprehension that distortion has occurred, it is best to wet the plaster model and readjust the wax. Adhesion of the base of the wax to the model may be avoided by first adapting to the surface a layer of thin gold foil and placing the wax over it.

To Insure Against Distortion of the Wax Model.—Cover the surface of the wax model with a thick coating of the investing material and allow it to set. Next lift the wax model and investing material together from the plaster model and invest in the flask.

A saddle may also be made of inlay wax by melting it in a spoon, applying it on the model with a brush and smoothing the surface with a wax spatula. This is a suitable method when a model of investing material is used and the saddle is shaped and cast directly upon it.

When rubber is to be vulcanized on the saddle or plate, to connect the artificial teeth, pieces of platinum wire as attachments should be inserted in the wax with the ends extended so that the wire shall be held in position by the investment in the casting. The ends of the cut-off sprues left after casting if properly located may also be used for the purpose.

CHAPTER VIII

FINISHING PROCESS. ELECTROPLATING

Finishing and Polishing.—The preparatory or preliminary dressing off of gold should be done with small carborundum wheels and points, first coarse and then fine, with the dental engine. This method is preferable for this part of the work to the use of files or the lathe.

First trim and finish interdental spaces and fissures. Thin vulcanized rubber and carborundum wheels and sandpaper disks are serviceable for the purpose. Narrow interdental and wash spaces are most effectively reached with pumice by applying it on a cotton cord. Fasten one end of the cord to the bench and holding the other end with the left hand draw the bridge back and forth



FIG. 62.

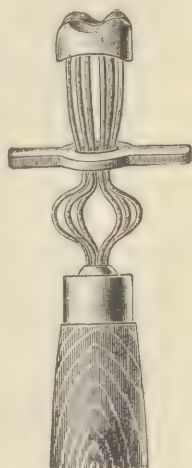


FIG. 63.

on the cord with the right hand (Fig. 62). Next polish the easily reached surfaces with pointed or flat felt cones with pumice and water or some other preferred polishing material. Then go over the entire bridge with a brush wheel, using fine pumice and soap until the surfaces are rendered perfectly smooth. Apply the soap by holding a piece of it against the revolving bristles for a moment. Wash off all the soap and pumice and for the final finish use whiting or rouge applied with polishing wheels on the lathe. Then thoroughly wash the bridge with warm water. As a holder for an all-gold crown while polishing, trim a piece of wood, about four or five inches long and one-half inch wide and shape the end to fit closely into the crown for use as a handle. A piece of heated impression

compound placed on the end of the stick and inserted in the crown will additionally secure it. Fig. 63 shows a crown holder that catches inside the crown.

Electro-plating

The surfaces of the different grades of gold composing a crown or bridge can be rendered uniform in color and more resistant to oxidation and discoloration by plating with pure gold. A plating outfit is readily constructed as described below. A plating solution to use with it consists of:

Chloride of gold.....	$\frac{1}{2}$ oz.
Cyanide of potassium.....	1 oz.
Water.....	8 oz.

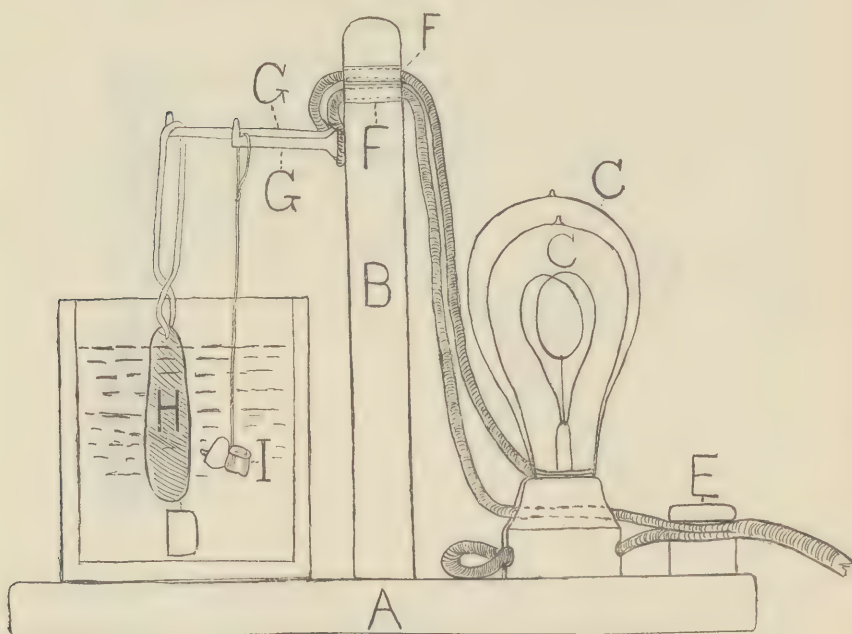


FIG. 64.

The plating outfit is illustrated in Fig. 64. The base (A) is a $\frac{7}{8}$ in. board, 1 foot long by 8 inches wide. The upright piece (B) is 9 inches high by 6 inches wide. Two carbon globes (C) are placed at one end, and the jar (D) for the solution at the other. For a 110-volt direct current use a 110-volt 16-candle-power lamp and a 220-volt 32-candle-power lamp placed in series to reduce the current. The wires are first connected to the plugs (E). The positive current is passed through

the two lamps and the negative current transmitted direct to the solution. The wires pass through the two small holes (FF) in the upright board (B). Two hooks (GG) are inserted under the holes. The negative wire is connected to one and the positive to the other at the shanks of the hooks as they are screwed into the board. On the positive side suspend in the solution a piece of pure gold plate (H) rolled very thin; the upper end of the plate is held by a clamp supported on the hook to which the negative wire is attached. The article to be plated (I) is held by a piece of copper wire looped over the hook connected with the positive wire. The positions of the positive and negative wires are distinguished the one from the other by first testing the current with the plating solution by the use of a two-piece plug and changing its position in the socket. When the position of the poles is determined the plug can be marked for future correct insertion.

Before plating, the metal should be trimmed, smoothed and polished, using pumice and whiting, and then boiled in a solution of lye and washed in warm water.

PART II
PREPARATORY TREATMENT OF TEETH AND
ROOTS FOR CROWN- AND BRIDGE-WORK

PREPARATORY TREATMENT OF TEETH AND ROOTS FOR CROWN- AND BRIDGE-WORK

GENERAL CONSIDERATIONS

Preparatory to crown and bridge operations the mouth should be put in the healthiest possible condition. The teeth should be first scaled of any calculus present, then cleaned and polished. Roots or teeth incurably affected should be removed, pyorrhea alveolaris if present treated and any existing lesions treated and cured; also, such measures should be adopted as will prevent the recurrence of old troubles or the inception of new.

Notwithstanding all that advanced knowledge of therapeutic agents and skill in their use permit, there are many teeth and roots which cannot be rendered suitable for the successful application of crown- and bridge-work. Roots which are permeated and softened by decay, exposed or loosened by absorption of the gingivæ and alveoli, or affected by irremediable disease of the investing membranes should be thus classed. Cases in which abscess with necrosis has extensively impaired the walls of the alveoli are equally intractable.

Experience shows that the results in this department of dentistry depend largely upon diathesis or constitutional tendency and upon the attention given to the preservation of the health of the mouth. These conditions should be carefully estimated in the selection of a system of treatment and the method of its application.

CHAPTER I

PREPARATORY PROCESSES

The preservation of the vitality of the pulps of the teeth or their extirpation in crown- and bridge-work is a subject that requires careful consideration.

The excision of natural crowns for the purpose of utilizing their roots for artificial crowns as abutments for bridge-work is extensively practiced, and has been in the past and is yet by some defended on the theory that the vitality of the dentin is to an extent maintained by the cementum after the extirpation of the pulp, or that the pulp, being the formative organ, is of no further value in a fully developed tooth when root-canal treatment is properly conducted.

The pulp after going through the progressive changes which constitute its original function assumes a fixed anatomical character as the source of the vascular and nervous supply from which the dentin derives and maintains its vitality. The protoplasmic bodies of the pulp unite with the living matter of the tubuli, which anastomose only to a very limited extent with those of the cementum through the intervening protoplasmic bodies in the interzonal layer.

This distribution and relative connection of living matter refers to an existing state of perfect vitality of all the parts. When the pulp loses its vitality, an entirely different condition results. The tubuli are then deprived of vital circulation, except along the lines of the outer portion of the dentin, where, in the interzonal layer, the fibrillæ occasionally anastomose with the living matter of the cementum. The vitality supported by this anastomosis is insufficient to take over the functions of the pulp and maintain circulation in the main body of the dentin. (See Plate I.)

The sheath of cementum on the surface of the dentin increases in thickness from the cervix to the apex, where it constitutes that portion of the root in its entirety. The cementum is provided with lacunæ and canaliculi. The living matter of the cementum being connected with the living matter of the pericementum, consequently what vitality there is in a pulpless tooth is dependent on the cementum and is proportionate to the normality of that membrane.

When the pulp has been removed, the devitalized fibrillæ still remain and, unless antiseptic root-canal treatment is thoroughly

carried out, their disintegration generates septic gases capable of causing infection of the cementum and pericementum.¹

An examination of the investing membranes of many pulpless teeth shows the existence through ineffective treatment of a large percentage of abnormal conditions, by which their firmness is to an extent impaired, their susceptibility to acute inflammation and liability to focal infection increased, and their reliability as foundations for crown- and bridge-work greatly lessened as compared with teeth which have living pulps. Frequently such conditions, when found in evidence in connection with the work of some of our best operators, are attributable more to difficulties that interfered with the perfect performance of root treatment than to carelessness or lack of skill.

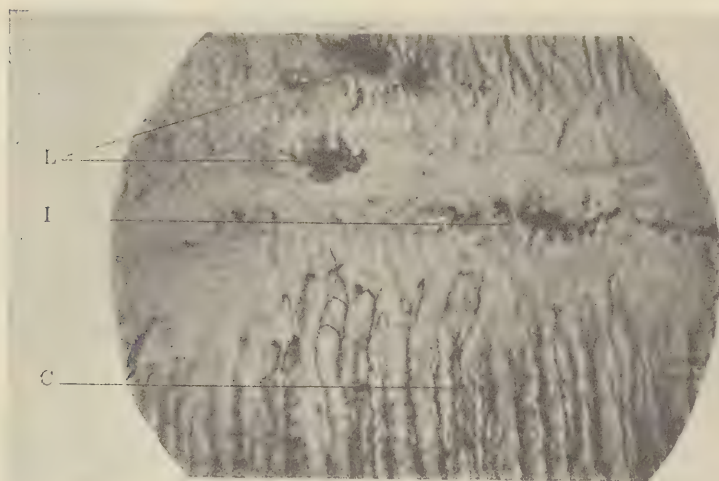


PLATE I.—L, Lacunæ of the cementum; C, canaliculi of dentin; I, interzonal layer— $\times 210$.

Observation also has shown that the dentin of gold-capped pulpless natural teeth in the course of years gradually softens sufficiently to impair their strength. Again, on the other hand, the extirpation of pulps often permits a better performance of details of operations, such as the shaping of natural crowns for crowning or for utilization as

¹ The analysis of dentin by Dr. G. V. Black gives an average of—

Lime-salts.....	63.54
Organic matter.....	25.36
Water.....	11.06

Age slightly lessens the proportion of living matter and increases the percentage of lime-salts.

supports for bridges; and the advantages thus gained are in the opinion of some proportionately of greater consideration than that of pulp conservation. Additionally, as the dentin calcifies as years advance, the proportion of living matter in it becomes gradually less; therefore the older the patient the less pulp extirpation has to be seriously considered.

The presence of a large filling or one that closely approaches the pulp, tends to partially or entirely calcify it in the coronal section. Consequently in such cases the dentin can be removed without the risk of causing irritation to the pulp or its exposure as when it is in normal condition.

A general study of the subject will show many methods of practice that will properly permit pulp preservation and in contra-distinction also indicate where a preferable condition will be insured by pulp removal.

Preparatory Processes

That extirpation of the pulp and excision of the natural crown, especially of an incisor or cuspid, is at times necessary for cosmetic effect and also to simplify the work and permit better forms of construction is undeniable. Besides, the question of root-canal treatment is not to be as seriously considered in relation to anterior as to posterior

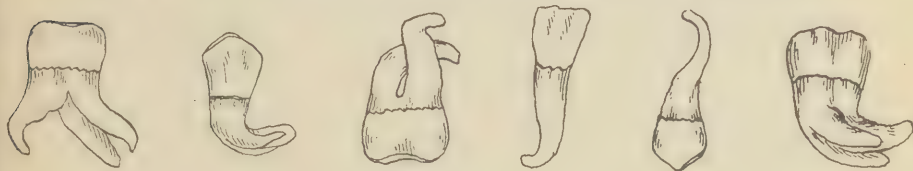


FIG. 65.

teeth where its perfect performance is not so easy of accomplishment. The removal of the entire enamel and a large portion of the dentin of, for instance, a bicuspid or molar tooth, is often necessary to properly shape it for a collar or cap-crown as a retentive abutment for a bridge if such a form is to be used. In such a case the removal of the pulp is frequently demanded and should precede the operation; otherwise, irritation of the dentinal tubuli is liable to follow and consequent lesions of the pulp. In such cases of pulp extirpation, as the future of the tooth depends on the effectiveness of the canal treatment that the circumstances will permit, it is advisable to take a radiograph that shows the form and condition of the roots and canals.

Cases such as are illustrated in Fig. 65 present difficulties that suggest the advisability of resorting to the use of the most favorable

method of bridge construction that will permit retention of the pulp, as a larger percentage of trouble results from ineffective root-canal treatment than from normal pulps degenerating under crown or inlay operations.

In all cases where bicuspid and molars are to be used as abutments, likewise in the incisors and cuspids when possible, the adoption of some one of the methods now in vogue by which they may be so utilized without pulp extirpation and with but slight mutilation should preferably be adopted.

Pulps which are in normal condition and still protected by a layer of partly decomposed dentin usually admit of successful treatment. In such cases the decayed dentin should be thoroughly excavated from the side-walls of the cavity, but that over the pulp need be only superficially removed.

Extirpation is always demanded for pulps in a *pathological condition* or whose *permanent preservation* cannot be placed beyond doubt, as failure involves more serious consequences in crown- and bridge-work than in filling operations.

The lesions of the pulp that require its extirpation are, all forms of exposure, congestion and pulpitis which do not yield promptly to remedial treatment.

Disinfection of Vital Dentin.—When decay has extensively involved the dentin and closely approached the pulp, as a precaution against subsequent irritation, thorough disinfection of the dentin and any remaining decomposed portion which may have been left over the region of the pulp is advisable.

The method of disinfection is to first thoroughly wash the cavity several times with tepid water thrown gently from a syringe around the sides of the cavity; then, taking measures to prevent the entrance of the saliva, wipe the cavity with absorbent cotton and pass over its surface a light current of hot air from a hot-air syringe. The heat should be sufficient to cause some discomfort to the patient but not enough to produce irritation of the pulp. The dried cavity is then immediately saturated with phenol previously warmed to the normal temperature of the body by holding the pellet of cotton on which it is applied over the flame of a lamp for a moment.¹ The carbolic acid relieves any pain caused by the evaporation of moisture and disinfects and sterilizes any decomposed matter in proximity to the pulp. The object of the application of the carbolic acid having been accomplished, the surplus may then be removed from the surface. To this end the

¹ Thermal shock to the pulp is as unwarranted from the application of cold carbolic acid as if produced in any other manner.

cavity should first be wiped with absorbent cotton and hot air again introduced to evaporate the moisture sufficiently to give a dry appearance to the surface of the dentin. This second application of hot air, owing to the effect of the carbolic acid, will cause little or no pain.

This method, if practiced early in the preparation of the cavity, will be found to considerably obtund sensation, and through the dryness secured, to materially facilitate the removal of the decomposed dentin. For excavating in the region of the pulp chamber, spoon-shaped excavators should invariably be used. For the thorough disinfection of dentin and the removal of hypersensitive conditions, the author practices the method of previously placing and sealing in the cavity for from two days to a week a mixture of precipitated chalk, carbolic acid and oil of cloves in equal parts. A small quantity of aristol may also be added.¹

The disinfected dentin over the pulp is next varnished with chlorogutta-percha and the chloroform evaporated with warm air, or some other preparation suitable for the purpose is used, and capped with oxyphosphate. When the capping is set, the remainder of the cavity is filled with the same cement as the capping or with an inlay or amalgam. The rubber-dam, when its use is practical, should always be applied in these operations. The shaping of the coronal section of a tooth for a crown or the preparation of the cavity for an inlay can then be proceeded with. In the latter case the cement can be trimmed as though it were dentin, leaving enough to fully protect the pulp.

¹ The chalk is placed in a mortar, and the carbolic acid and oil of cloves gradually introduced and thoroughly incorporated with the chalk by trituration until the mixture becomes a plastic mass. The aristol is then added and trituration continued until the aristol is thoroughly incorporated in the mass.

CHAPTER II

DEVITALIZATION OF THE PULP

When devitalization is necessary in preparation for crown-work two methods are practiced: the heroic—instantaneous devitalization—and gradual devitalization by arsenical treatment.

Instantaneous Devitalization.—This is accomplished by first opening into the dentin or cavity in the direction of the pulp (Fig. 66), then administering to the patient sufficient nitrous oxid to produce anesthesia and with a drill quickly exposing and lacerating the pulp well up the canal with a probe or smooth broach. Instantly afterward a pellet of cotton saturated with carbolic acid is forced up the canal and, if possible, left until the next day, when the pulp will be found in a coagulated mass that is easily removed entire.

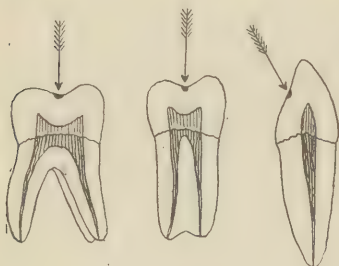


FIG. 66.

Use of Cocain, Cataphoresis and Pressure Anesthesia.—In cases of actual exposure of the pulp and those in which the patient permits its exposure by removal of the decay or the use of a small spear-shaped drill, the rubber-dam is applied, the exposed pulp obtunded with adrenalin and cocain (Parke, Davis & Co., Hypodermic Tablets No. 115) in tablets applied in saturated solution. The diffusion may be hastened by electrolysis.

Pressure anesthesia is effected by first removing a small portion of the enamel in the direct line of the pulp, then piercing the dentin with a fine spear-shape drill as deeply as possible without causing excessive pain. The cocain solution is then introduced on a few fibers of cotton placed in the hole drilled. Pressure is next exerted on the solution with a ball-shaped burnisher on a pellet of unvulcanized rubber inserted in the cavity. The pressure should be directed in the line of the pulp. As soon as the action of the cocain is manifested the drilling should be continued and the solution again applied. The solution is to be gradually worked into the pulp as soon as it is exposed, with a fine

smooth-pointed broach; or injected. After the lapse of two or three minutes the pulp can be painlessly extirpated.

The subsequent vitality of the cementum is assured by the instantaneous procedure in pulp extirpation, and discoloration of dentin and enamel is minimized as much as possible, but when the natural crown is utilized in bridge operations, the translucence of the teeth is usually impaired by pulp removal.

Devitalization with Arsenic.—The methods of devitalization previously described are most successfully applied to normal or only slightly calcified pulps. Pulps of teeth extensively calcified, molars especially, do not so well permit the instantaneous methods. Consequently recourse at times is had to arsenical treatment with highly nervous, sensitive patients, notwithstanding the numerous objections to its use. Two theories as to the mode of its action in devitalizing are widely entertained: First, that its toxic effects produce hyperemia, which stops circulation; second, thrombosis. This theory of thrombosis might account for the gradual devitalization of the pulp toward the foramen.

Whatever the action of arsenic on the pulp may be, it causes some infiltration of the tubuli of the dentin with certain constituents of the blood, probably the liquor sanguinis. To an extent the residue of the infiltration, after the devitalization of the pulp, remains in the tubuli, increasing the difficulty of producing an aseptic condition of the dentin and proportionately causing its discoloration. This discoloration is most marked when arsenic is applied to dentin over an unexposed pulp. It is asserted that arsenic sometimes affects the vitality of the cementum by its diffusion to the zone around the apex of the root.

Arsenic when used, should be applied directly to the pulp in the smallest quantity possible to effect devitalization, and securely sealed in the cavity. In cases of non-exposure requiring its application, a small opening into the pulp-chamber if possible should be made. This can be accomplished, as already described, with but little pain to the patient.

Arsenic may be combined with creosote or carbolic acid in the smallest possible proportion of the arsenic that will effect devitalization, or with agents which are non-coagulants of albumin. Dr. Harlan's method to avoid using coagulants of albumin is to apply an anodyne, such as wine of opium, for a minute or two, and then the following paste:

R. Arsenous acid,	ʒi
Muriate of cocain,	ʒij
Lanolin in quantity sufficient to make a stiff paste.	

No arsenical application should be kept in position longer than is necessary to effect devitalization of the pulp, twelve to forty-eight hours being sufficient. The short period refers to a case in which there is no calcification and application is made in direct contact with the pulp. The longer periods are where the application is not quite direct, or where the pulp is slightly or considerably calcified. The pulp-chamber is then opened, syringed out with the saline solution or alcohol, a saturated solution of tannin in glycerin applied and securely sealed in the cavity, and the patient dismissed for a day or two when, in favorable cases, the pulp can be removed entire.

CHAPTER III

PULPLESS TEETH

Requirements of Treatment.—The treatment of pulpless teeth or roots consists in as thorough performance as possible of the following procedures:

First: When a pulp has just been removed, proper opening up, removal of its contents and enlargement of the canal to the area of the cementum at the root-apex with only a slight enlargement of the canal in the cementum to, but not through the foramen.

Second: In cases of focal infection proper enlargement of the canal to and through the foramen to the infected area.

Third: Antisepsis of the root-canal and dentin and the establishment of permanent aseptic conditions by mummification of the contents of the tubuli.

Fourth: Closure of the apical foramen, filling of the canal and its orifice in a manner that will ensure against infection through the foramen and from the oral cavity.

Preparation of Root-Canals.—A knowledge of the usual form and position of the roots and of the different teeth and the orifices and lines of the root-canals (See Plate II and Figs. 127 to 135 inclusive) is essential for a generally successful performance of this operation. The procedure is greatly simplified since the introduction and use of radiographs that definitely show the length and form of the roots and canals to be operated on, as well as any abnormality present. The direct access in the line of the root-canals that is obtainable in crown operations greatly facilitates the work of effective treatment.

In all cases, in the preliminary removal of tooth structure sufficient of the crown should be left to easily permit the application of the rubber-dam and the retention of dressings with gutta-percha seals. When teeth are broken down or extensively decayed beyond the gum margin and hypertrophied gum tissue invades the cavity, the diseased tissue should be removed, the cervical section of the margin of the cavity excavated and an antiseptic dressing applied.

The cavity should then be packed with gutta-percha well anchored either against the adjoining tooth or in the orifice of the pulp cavity in



PLATE II.

such a manner as to stop hemorrhage and press back the tissue slightly beyond the edge of the cavity and expose it for the next stage of the treatment, as shown in a case of approximal decay in Fig. 67 and decay on both sides in Fig. 68. In cases where the side wall of a tooth is so far decayed under the gum margin as to render application of the rubber-dam either extremely difficult or impracticable, a thin collar or matrix may be adapted to the peripheral sections and ce-

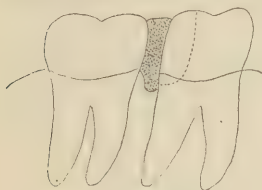


FIG. 67.

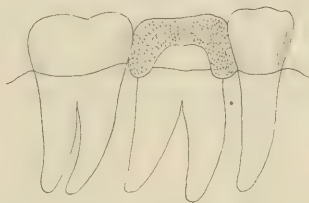


FIG. 68.

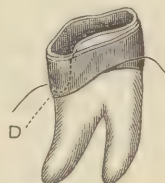


FIG. 69.

mented in position with oxyphosphate cement, as shown in Fig. 69. D indicates the cervical line of decay. When the cement has set, the rubber-dam is applied and enough of the cement removed with a bur to expose the pulp cavity and permit the root-canals to be treated and filled. The collar may remain on during the treatment. When treatment and root-canal fillings are completed, the cavity inside the

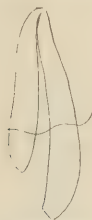


FIG. 70.

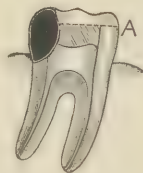


FIG. 71.—Sectional view of an inferior-molar decayed on the posterior approximal side. A, The line to which the crown should be removed to facilitate entrance to the pulp-chamber.

collar can be filled with amalgam or first lined with oxyphosphate and the amalgam inserted while the oxyphosphate is still soft. When the amalgam has set the collar is removed.

In the preliminary treatment of an infected pulpless tooth a fine probe should always be inserted in the root-canal, to be withdrawn when the temporary filling is completed, to leave a vent for the escape of gases. Pressure should be exerted with an instrument on the temporary filling to prevent its displacement as the probe is with-

drawn. First remove the tooth structure over the pulp-chamber in the direct line of the canal. Where the coronal section of a normal incisor or cuspid is to be preserved, operate from the lingual side, Fig. 70. The removal of the coronal section of teeth directly exposes the pulp-chamber. In bicuspid and molars for an all-gold crown, the occlusal surface and the side walls of the cavity should be removed, to give direct access to the canals (Fig. 71). The pulp-canal of an incisor or cuspid is easily reached; bicuspid and molars are more complicated. When the buccal roots of the superior molars join together, the canals incline to a similar condition, and in the third molars the buccal and lingual canals occasionally unite and form one large canal. These are conditions that are usually indicated to the operator by the radio-



FIG. 72.

graph. In the case of the superior molars, the canal of the palatal root is the first that should be located, and in the inferior molars the canal of the distal root. By locating these canals the others can more easily be found in normal cases. In cases of extensive calcification frequently the orifice of each canal must be separately located. If the orifice of a canal is not apparent, endeavor to locate it with a pulp-canal pick (Fig. 72) by prodding the dentin in the expected location. If calcification has only partly closed it, prodding with force will usually disclose it. If the orifice is entirely closed, remove some of the dentin, guided by a radiograph, and again apply the pick. When entrance to the canal has been effected, probe it with a fine sharp-pointed broach to determine its direction and length. Next enlarge the orifice with a cone-shaped bur or a Gates-Glidden drill (Fig. 73) so as to give it a funnel shape to guide the points of instruments into the canal.

For effective root-canal treatment the operator should be equipped with a full set of the most approved broaches, root-canal files, drills,

and reamers for use both in hand and engine (Figs. 73, 74, 75, 76 and 77).

The orifice of the canal having been opened up, if a devitalized pulp is present, remove it with a fine Donaldson barbed broach by

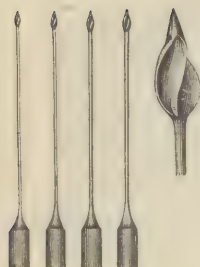


FIG. 73.



FIG. 74.

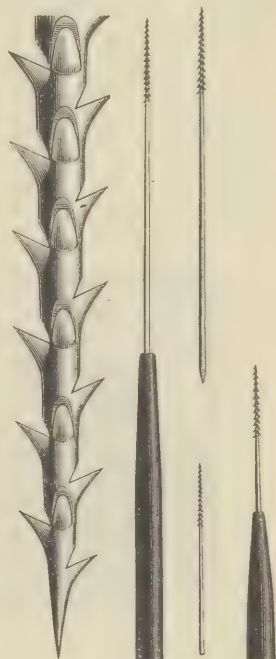
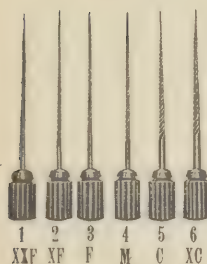


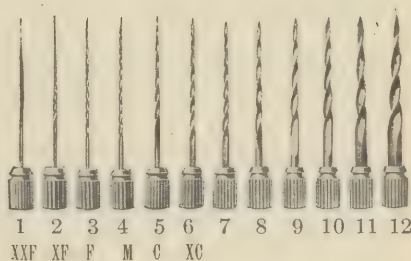
FIG. 75.



1 2 3 4 5 6
XXF XF F M C XC

Style B

FIG. 76.



1 2 3 4 5 6 7 8 9 10 11 12
XXF XF F M C XC

FIG. 77.—Root-Canal Reamers.

passing the broach as far up the canal as possible, then entangling the pulp on the barbs. This is best done by moving the broach a little upward and downward and twisting it slightly in the downward movement. Next, guided by frequent explorations with a fine pointed broach (Fig. 74), the canal is carefully enlarged with Kerr's root-canal

files (Fig. 76) and Donaldson broaches (Fig. 75). They should be used delicately with an up-and-down motion, beginning with the smallest first and then increasing in size.

A 75-per cent. aqueous solution of sulfuric acid carried on a fine platinum probe to the canal, then pumped into it with a small broach, is most effective as an aid in opening up very small canals or those partly closed by calcification. In the former case the acid softens the dentin of the sides of the canal so that the friction of a smooth broach will materially enlarge it. In the latter, in addition to this effect, it decomposes the calcified contents of the canal. The enlargement of the canal with a smooth broach permits the introduction of root-canal files and then Donaldson barbed broaches, first small and increasing in

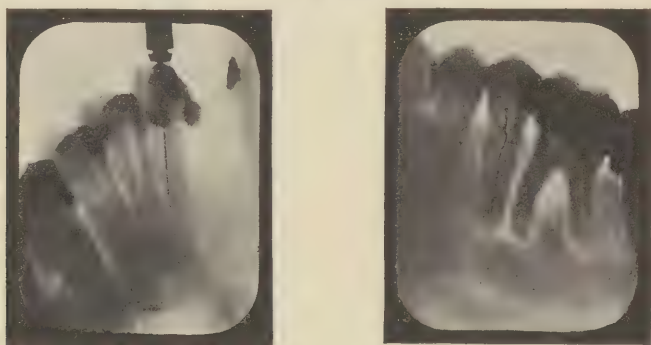


FIG. 78.—Radiographs showing wires in root-canals.

size, by which the canal can almost invariably be safely opened and enlarged to the zone of the cementum and, when alveolar abscess exists, through the foramen. When so opened, they can be thoroughly divested of organic matter by the action of the acid and use of the broaches.

The application of acid in root-canals of normal teeth should not be carried further than the zone of the cementum at the apex, for, should it penetrate the foramen and reach the pericementum, it is liable to cause irreparable injury to that membrane. When the acid has accomplished its purpose it should be removed and its further action neutralized by sodium bicarbonate solution.

A canal may be slightly enlarged to the foramen to facilitate root-canal filling, but not through to the apical space except when an area of focal infection or abscess is present. The depth to which a canal is or has been penetrated can be determined by the insertion of metallic wire into the canal and then taking a radiograph with the wire in

position. This is repeated as often as is deemed necessary during the operation (Fig. 78).

It should, though, be borne in mind that divergence of a broach from the line of a canal is indicated *according to the angle the radiographic rays have been cast*. Accordingly, any divergence of a broach in a canal in either a lingual, labial or buccal direction is not always as certainly determined. For this reason if any doubt exists radiographs should be taken at three different angles.

When a canal has been penetrated and slightly enlarged with root-canal files or broaches, apply reamers (Fig. 77) or Gates-Glidden drills (Fig. 73) from a small to a large size, as the case requires. The distance a reamer should be used up a canal and the size of the reamer are regulated by the form and size of the root and whether or not the canal is to carry an anchorage post.

Reaming, with hand reamers or with Gates-Glidden drills—which are practically reamers—and the engine, should be done with a slight up-and-down movement as they are revolved and with very little pressure applied. Under too much pressure the instrument might be broken off, or in a straight root be forced through the foramen. Nor should reamers be forced into canals closed by calcification or into a curved root. A slight pain is usually experienced under normal conditions when they enter the zone of sensibility formed by the cementum which composes the end of the root, of the slightest symptom of which the patient should be instructed to instantly inform the operator. The probe-like points of the Gates-Glidden drills do not cut but simply guide the drills and confine them to the line of the canal. They should be frequently sharpened with an Arkansas stone of knife-blade form. An occasional quick withdrawal of the drill from the canal during the process of drilling will aid the removal of the debris.

Moderate reaming of a root-canal, in addition to simplifying the operation of filling, opens up the ends of the tubuli and facilitates the permeation of antiseptic agents. Opening up root-canals evidences the skill of the operator and when effectively performed and associated with correct filling insures the success of the operation.

If the radiograph shows roots that are small and curved, the orifice to the canal should first be given a funnel shaped form. The canal is then enlarged with root-canal files bent to the curve of the root as they gradually penetrate to the apex. The canal enlargement should be sufficient to allow the foramen to be properly closed and the canal filled.

Entire Calcification of Pulp-Canal.—In a case of entire calcification and obliteration of the canal, guided by radiographs at different angles, the center of the root should be opened up in the line of the track

formerly occupied by the pulp, with round burs proportioned in gage to the former canal and in depth as far as is safe without risk of penetration of the side of the root or apex. The dentin is then mummified by applications of a saturated solution of aristol in the essential oils, repeated at intervals of three or four days, until the dentin is darkened in shade, indicating its thorough permeation. The diffusion is assisted by introducing at each application a heated root-canal drier into some of the solution placed in the canal. In these cases the foramen being closed by calcification the canal is best entirely filled with zinc oxychlorid.

Treatment.—Pulpless teeth are presented for treatment in one of the four following conditions:

1. Where the normal pulps have just been extirpated from the canals.
2. Where on opening into the pulp-chamber, the pulp is found partly or entirely calcified in the canals with little or no vitality and the root externally in a healthy condition.
3. Where the pulp is found in a pathological or a putrescent condition.
4. Where alveolar abscess is present and a septic condition of the canals and dentin exists.

In the first and second classes the treatment should be directed to assuring a continuance of the existing aseptic condition and the filling of the canal; in the third and fourth classes, to bringing about an aseptic condition by disinfection and sterilization and making certain of its future maintenance, including incidentally the cure of any existing disease of the external membrane of the alveolus.

In cases of the first and second classes, if possible, saliva should be excluded from the pulp-chamber and canals during their entire preparation and filling. If necessary to syringe out the canal, the saline solution or alcohol can be used instead of water. The instruments should be sterilized and broaches, if serrated, had better be new. In the third and fourth classes, exclusion of saliva or water is not necessary in the preliminary work on the canal; and water may be freely used until the process of disinfection and sterilization is commenced, after which its entrance should be prevented. To this end the rubber-dam should be applied if practicable. When not, as frequently occurs with roots and teeth badly affected with cervical decay, they should be treated as shown in Fig. 69, or other means of keeping out moisture be resorted to. In such cases, when the rubber-dam is not applied and cotton rolls are used, during each interruption of the operation the entrance to the canal should be packed with absorbent cotton saturated with alcohol, the saliva being thus excluded.

In cases of the third class in opening up the canal great care should

be taken not to force any of the septic matter through the foramen and cause infection of the apical space. This is frequently difficult to avoid; so, as a precautionary measure, at first open up only the orifice of the canal, then introduce and inclose in it—leaving a large vent—antiseptic agents until by diffusion its contents are rendered inert.

After the canal has been properly opened up and its contents removed, it is washed out with alcohol and wiped with absorbent cotton, and is then ready for further treatment. The use of sodium potassium is recommended by Dr. E. C. Kirk at this stage as a germicidal saponifier and to open up the ends of the tubuli, but, as in the use of sulfuric acid in normal cases it should not be allowed to reach the zone of the cementum.

The next procedure is to secure as thorough a state of dryness in the pulp-chamber as is possible, by forcing into it hot air with a hot-air syringe, (hand or electric), at a temperature higher, as it leaves the nozzle, than is comfortable for the finger. A root-canal drier with a tapered point may then be introduced into the canal, preferably with the point of silver and the bulb of copper (Fig. 79). As silver possesses remarkable properties as a thermal conductor, the heat is transmitted to the point of the probe very rapidly. The probe being inserted as far as possible up the canal (Fig. 80), the patient is directed to raise the hand as a signal should the heat cause pain, in which case the probe must be moved up and down or withdrawn for a moment. This procedure, following the previous application of the hot air with the syringe, evaporates the moisture and aids the escape of any gases present in the root-canals and the open ends of the tubuli.

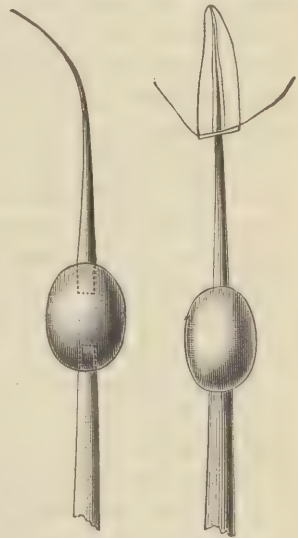


FIG. 79.

FIG. 80.

The point of the root-canal drier acts as a sterilizer and may be applied so hot as to carbonize any organic matter it reaches in the end of the canal, a portion of which may be removed each time on its point. As the silver point can be tapered as small as the finest broach, canal contents impossible to entirely remove with broaches may be reached and either removed or rendered inert.¹

¹ Use introduced by the author in 1887 and use of hot-air published in article in the *Herald of Dentistry* in 1884.

In cases of the third or fourth class, sepsis being present, the heat is very serviceable, as it aids the escape of septic gases from the canal and dentin by their dilation and acts as a germicide. When in this dry and heated condition the dentin is in the best possible state for the application of antiseptic agents.

Use of Antiseptics.—Great diversity of opinion exists as to the suitability of various antiseptics in treating tooth-structure, their effectiveness and permanency when so used, whether singly or in combination, and their adaptability to various conditions. Many of the antiseptics in common use, being coagulants of albumin, obstruct the dentinal tubuli and their diffusibility through the dentin is consequently retarded. To this class belong phenol, creosote and the like. They are not entirely non-diffusible in devitalized dentin or cementum, as decomposition effects elementary changes in the contents of the tubuli, but their action is slow and limited as compared with that of some other agents, as the essential oils. The former are also irritants and unsuitable in cases where an acute or chronic inflammation of the peridental membranes is to be treated.

Formalin in the form of Formocresol is recommended by Drs. Kirk and Inglis. There is no question as to the efficiency of formalin, but on account of its irritant properties it should be used with great caution. It should not be introduced up the canal as far as the zone of cementum at the apex and a vent should be left in the filling placed over it sufficiently large to permit free escape of the formalin gas into the oral cavity instead of being forced up in an apical direction.

The essential oils, which are non-coagulative in their action, have greater diffusibility and, according to Miller, Harlan and others, possess much greater antiseptic power than was formerly attributed to them. For this reason the essential oils in combination with preparations of iodine that exert a chemical action and retain their antiseptic properties for a great length of time, are the most approved.

The selection of antiseptic agents is therefore important, and the choice is indicated by the conditions presented in a pulpless tooth. A tooth from which a healthy pulp has just been extracted with the canal in an aseptic condition differs in its requirements from a case in which sepsis of dentin or a diseased or putrescent pulp is present.

In the first mentioned conditions the advantage of the antiseptic agent in the canal is to better assure the continuance of the state of asepsis. When a healthy pulp has just been extirpated and immediate root filling is practiced, the use of phenol or creosote is indicated. The minute fibrous connections with the wall of the canal and the vessels at the apical foramen are severed and the action of an escharotic

antiseptic agent is in fact required, as it acts as a coagulant and instantly seals up the ends of the tubuli. If immediate root filling is not to be practiced, then the prescription of such agents as the essential oils with aristol or iodoform seems suitable, as by their action a sort of mummification of the non-vital organic matters follows. Moreover, the oils possess advantages over the coagulants in that they are not miscible in water and are less easily eliminated. Their use will tend better to perpetuate an aseptic condition.

In the second class of cases, also in teeth of the third and fourth classes with sepsis of dentin, or diseased or putrescent pulps, we need the intervention of agents which will not only destroy ptomaines but which will exert a chemical action on sulfureted hydrogen and ethereal ammoniacal gases, the products of putrefaction, and entirely eliminate them. On this depends the successful treatment of such cases, for until disinfection of the dentin is absolutely accomplished the canal is not in a suitable condition to be closed. Carbolic acid, creosote or the essential oils, under such circumstances, exert no chemical action on these gases, merely disguising their odor, though it is true that by repeated dressings of cotton saturated with one of these agents, the gases are absorbed by the cotton and slowly eliminated.

What is required is the action of disinfecting agents whose elements possess an affinity for these gases and so will immediately decompose them, forming new combinations and entirely changing their character.

In accordance with this principle, iodine is indicated as preferable to the other agents mentioned. Its effects are best obtained from some one of the preparations in use, preferably aristol (dithymolbiniodid) from which nascent iodine is liberated, the odor of which is not objectionable, in a strong or saturated solution in one of the essential oils. In practice the oils of cloves, cassia, myrtol and eucalyptol are favored for this purpose, the first named being reckoned more sedative in its action than the others. The canal should be flooded with the solution, thereby to some extent permeating the dentin, as well as the cementum at the apex. A more complete saturation can be accomplished by drying and heating the dentin and applying the solution several times, or by filling the canal with cotton saturated with it, hermetically closing it and letting it so remain for a day or two.

Discoloration of Dentin.—As aristol in combination with oil of cloves or cassia has a tendency to slightly discolor dentin, its use should be confined to the extremity of the root-canal and plain oil of eucalyptol or myrtol used in the orifice and coronal section of the tooth where maintenance of the natural shade of the crown is to be considered in an

operation. When a normal pulp has been extirpated from an anterior tooth and the crown is to be preserved intact and its shade maintained, oil of myrtol should alone be used; and the foramen within a day or two, if not immediately, should be closed with gutta-percha and the canal filled with zinc oxychlorid.

The disadvantage of immediate root filling is that should some minute fragment of the pulp remain in the extremity of the canal, it fails to receive the benefit accruing from the reapplication of antiseptics, which would better assure its inertness by mummification.

In the treatment of a root-canal from which a pulp has just been removed or when no pathological condition exists at the apex, an acute inflammation of the pericementum of that part is frequently produced from the applied antiseptic agent being pressed or pumped through the foramen and invading the apical space. Such cases are relieved by washing out the canal with alcohol, applying the alcohol as a dressing and tightly sealing the entrance to the canal with oxyphosphate cement for a few days. To avoid such an inflammation the author at first applies the essential oil diluted with alcohol or chloroform. The solution is applied on cotton,—from which all excess is removed by pressing it in bibulous paper,—gently packed in the canal and sealed with gutta-percha or cement for a day or two. At the next treatment the foramen and only the extreme end of the canal are closed with gutta-percha as shown at GP, in Fig. 81. The treatment can then be continued and the antiseptic—even preparations containing formalin—be applied in the canal in full strength with safety.



FIG. 81.

The dressing of root-canals is best performed with the aid of ordinary smooth flexible rectangular broaches, and with root-canal dressers. The form of these instruments permits fibers of cotton to be easily wound around them lengthwise and over the point in one connected mass. When the cotton is introduced in the canal, it is retained on and carried forward by the instrument which, when withdrawn, leaves the cotton in position in the canal in the form of a cone or tampon that in septic cases will favor the escape of gases and may still be easily removed at any time. After one or several treatments in the manner described, between which, if intervals of time are to elapse, the antiseptic agents must be hermetically sealed in the cavity with gutta-percha or oxyphosphate or a small quantity of gutta-percha covered with oxyphosphate. When the treatment is completed the canal is dried and the foramen closed, if this has not already been done, and the canal filled.

Closure of the Apical Foramen and Filling of the Canal.—The object of root-canal filling is the maintenance of an aseptic condition in a sterilized root-canal by *hermetically closing it at both the apical foramen and the orifice*, thus preventing its infection by the entrance of either fluids or gases *in the zone of the cementum*. Gutta-percha to close the foramen and fill only the extremity of the canal and zinc oxychlorid to fill the remainder and the orifice are generally accepted as most suitable and reliable.

The canal having been washed with alcohol and dried, the extreme end of the canal is first pumped full of chloro-gutta-percha with a broach or small probe, and any surplus towards the orifice of the canal absorbed with cotton. A small cone of solid gutta-percha of suitable size to fill the extreme end of the upper third of the canal is then inserted and pressed into the chloro-gutta-percha. The cone is best carried to position by heating the point of a small root-canal plugger and attaching the cone on the point, as shown at A, Fig. 82. The cone is then placed and *gently pressed* but *not suddenly pushed* into position in the canal and detached from the plugger by giving the plugger a sudden twist.

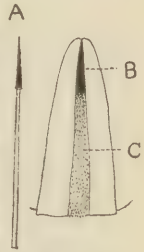


FIG. 82.

The gage of the point of the plugger used should always be slightly larger than the foramen so as to avoid the risk of pushing the point through in packing the gutta-percha. A current of hot air is next thrown on the end of the cone at a temperature sufficient to soften it and warm the dentin, when it should be again *gently pressed* up the canal. A slight twinge of pain to the patient will usually be the signal of its complete impactment in the end of the canal. The solid gutta-percha absorbs what little chloroform is present, the heat then evaporates the chloroform and the pressure condenses the gutta-percha. If the process of heating and condensing is repeated sufficiently, the gutta-percha can be solidly condensed. A root-canal drier (Fig. 80) may be used to assist this operation. The shrinkage is thus reduced to a minimum or entirely overcome.

The advantages possessed by zinc oxychlorid over other materials are its antiseptic qualities and its density. Its disadvantages are its destructive action on the tissues if even the smallest amount should protrude through a foramen, and the difficulty attending its removal from the extremity of the canal, should conditions require that course. These objections are removed by filling the extreme end of the upper third of the canal, as described, with gutta-percha. The remainder of the canal and the pulp-chamber are filled with the oxychlorid. To effect this proportion of the oxychlorid, remove any excess of the gutta-

percha present from the orifice and lower section of the canal with a round-headed bur to a point such as is shown at B. The oxychlorid should be mixed very thin, carefully pumped up the canal and compressed with an instrument or cotton as it sets (C).

The combination of gutta-percha and zinc oxychlorid forms an ideal root-canal filling, as the zinc oxychlorid hermetically closes the orifice of the canal and prevents its infection from the oral cavity.

When metallic points of lead or copper, shaped to fit, are used to fill root-canals, unless a small quantity of chloro-gutta-percha is first placed in the extremity of the canal, the complete closure of the foramen is doubtful. The best method is to close the foramen with gutta-percha, pump up the canal a thin mixture of zinc oxychlorid and then insert the metallic point.

The use of cotton as a filling in root-canals is to be condemned. A few fibers of iodoformized cotton mixed in with the zinc oxychloride¹ may be used as a vehicle to aid in carrying zinc chlorid to position in the canal, especially of a superior root. Asbestos fiber is given preference to cotton by some. Tin or gold foil makes an effective root-canal filling, but is difficult to insert without leaving vacuoles. Paraffin combined with a small quantity of aristol as a material to fill root-canals has been suggested by Dr. Kirk, especially after the use of sodium potassium. This agent, being a most active solvent of albuminous matter, in a measure frees the ends of the tubuli of a canal of their organic contents, a favorable condition for the use of paraffin. Paraffin is aseptic, melts at a low temperature and, with a heated root-canal drier can be flowed into the ends of the tubuli or into a minute canal not considered safe to open up extensively. Recently, chloro-rosin has been recommended by Dr. Callahan as a root-canal filling that will penetrate the exposed ends of the tubuli in the dentin and adhere to the walls of the canal.²

R̄ Rosin gr. xi

Chloroform ℥ iii

Ordinary gutta-percha should be used to close a foramen when an abscess has just been treated by injecting through it. The rubber-dam is placed on the root or it is otherwise protected from the saliva, the canal washed with alcohol, and dried. The length of the canal should be measured with a hook-pointed broach and gaged with a small

¹ Cotton may be sterilized by immersing it for a time in a saturated solution of iodoform in ether, and then drying. It should be kept in a tightly-corked bottle. The odor of iodoform in the operating-room is thus avoided.

² Silver Nitrate and Formalin, termed the "Reduction Method," and other preparations have been recently introduced, but have not been sufficiently tested in practice to warrant their indorsement in a text book.

perforated disk of rubber-dam slipped upon the instrument, as shown at D, Fig. 83. The gutta-percha should then be carried to position on the point of a canal plugger, the point having been heated just enough to cause slight adhesion of the gutta-percha F. An allowance should be made for the displacement of the instrument by the cone on the point by comparing the length with the broach, E. The cone is then detached from the point and left in position in the apex by giving the instrument a twist, G. As oil of eucalyptus is a solvent of gutta-percha, the application of this oil to the surface of the gutta-percha is recommended in its final insertion, as better adhesion to the walls of the canal is thus obtained.

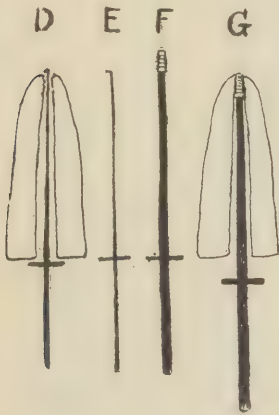


FIG. 83.

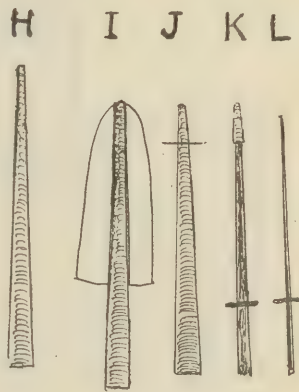


FIG. 84.

To properly fill and close an enlarged foramen, an accurately fitted plug of gutta-percha should be used. This can be obtained by rolling a strip of pink base-plate gutta-percha into the form of a long tapering cone, as shown at H, Fig. 84, with a slightly heated spatula on a glass slab which has been dipped in hot water.¹ With the end of the cone held by the fingers, the point is inserted up the canal and pressed into the foramen, and the line of the surface of the end of the root marked on the cone, which is then withdrawn. The length of the cone in the canal is compared with the measure of the canal, as shown by the broach L and the surplus that protrudes through the foramen is cut off. The cone is again inserted up the canal, marked, then removed and trimmed until the cone fits closely in the apex of the root, as illustrated at I. It is then removed and about one-fourth of an inch of the section that fits into the foramen is cut off, J. The cut-off portion is next mounted on the point of a canal plugger which has been heated in an alcohol flame

¹ Method suggested to the author by Dr. Otto E. Inglis.

just enough to cause adhesion of the gutta-percha, as shown at K. A little of the point of the cone is then trimmed off, causing the remaining portion, which is slightly larger, to require pressure to place it in position in the foramen. The length of the canal is then gaged on the shank of the plugger from the point of the cone with the rubber-dam,

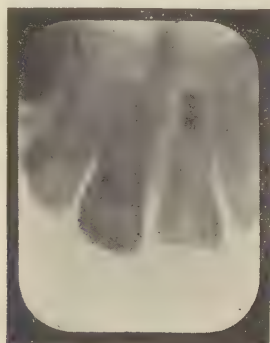


FIG. 85.—Radiograph of a fractured central incisor of a boy nine years old with the large foramen incident to his age closed with a measured gutta-percha cone and the remainder of the canal as yet unfilled.

which has previously been placed there, as shown at K and L. The canal is next washed with alcohol and dried. The cone, having been dipped in oil of eucalyptus, is inserted and pressed up the canal until the disk on the plugger meets the surface of the end of the root, which



FIG. 86.

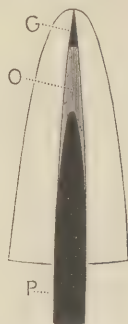


FIG. 87.—G, Gutta-percha; O, oxychlorid; P, post.

indicates that the cone is in correct position in the foramen. The plugger is then twisted around several times to disengage it from the gutta-percha. Fig. 85 shows a case treated as described. If the plugger is pressed beyond the line at the disk, the gutta-percha will be proportionately protruded through and beyond the foramen.

When two canals in a root terminate in the same foramen, it is best closed by first filling the canal through which the foramen is most easily reached (Fig. 86), after which the other canal is filled. Ample room should be left in any root-canal which is to receive the post of a crown, as any part of the canal not occupied by the post will later be filled with the cement.

When a post has been fitted to a canal previous to the closure of the foramen, the foramen should first be closed with gutta-percha, then the oxychlorid pumped up the canal and the post inserted. When the cement is about half set, the post is seized with pliers and withdrawn and not again inserted until the cement is perfectly set. In this manner an oxychlorid socket is formed into which the post will fit accurately (Fig. 87). The same can be done with the post of a finished crown, if the foramen has been previously closed with gutta-percha.

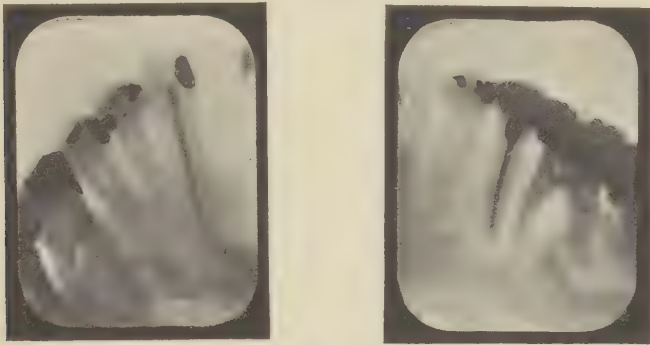


FIG. 88.

A pulpless tooth presented for crowning, the roots of which have been treated and filled in some previous operation, should be carefully examined. If the slightest doubt is entertained as to its hygienic condition, it should receive antiseptic treatment as previously described, as the ultimate success of crown-work depends primarily upon the thoroughness of the preliminary operations. Fig. 88 shows radiographs of properly filled root-canals, which are the superior cuspid and inferior bicuspid shown unfilled in Fig. 78.

The approved method in practice is to take preliminary radiographs to determine the form and condition of roots and canals of teeth and then again other radiographs during stages of the treatment, and finally to determine the effectiveness of the operation.

CHAPTER IV

PATHOLOGICAL CONDITIONS

Many teeth and roots presented for crown-work are affected with chronic alveolar abscess. A general description of an effective method of treatment is therefore properly associated with a discussion of the subject.

The cause of chronic alveolar abscess will be found in a continuation of those conditions which originally produced the acute form. The teeth or roots being pulpless, pyogenic organisms and septic gases, generated by the decomposition of organic matter in the root-canal and in the tubuli of the dentin, find an outlet through the foramen into the apical area; or imperfect treatment of the canal and closure of the foramen or failure of the root-canal filling to effectually close the foramen and the orifice of the canal and prevent infection from the oral cavity, that causes pericementitis and formation of pus. The general treatment consists in the removal of all septic matter and gases from the root-canal and dentinal tubuli, the destruction and removal of the pus sac, the application of suitable therapeutic agents and the adoption of measures to prevent further formation of pus.

The Usual Forms.—Chronic alveolar abscess is usually found in the following forms: First, abscess with fistulous opening through the alveolus and gum and accessible through the root-canal and foramen. Second, abscess with fistulous opening but not accessible through the apical foramen. Third, abscess without a fistula and from which pus discharges through the apical foramen and root-canal, or does so as soon as the foramen is opened, termed "blind abscess."

Abscess of the First Form.—In the treatment of an abscess of the *first form*, the canal should be enlarged, as described in the treatment of pulpless teeth, and the foramen opened with broaches without the use of a drill. Aromatic sulfuric acid on cotton placed in the end of the canal for a day will usually open up the most minute foramen.¹ A small quantity of 75 per cent. aqueous solution of sulphuric acid pumped into

¹ Suggested by the author in paper read before the Section of Oral and Dental Surgery of the Pan-American Medical Congress, Washington, D. C., September 7th, 1893. Published in *Dental Cosmos*, October, 1893.

the extremity of the canal will often enable a broach to instantly effect a passage. The saline solution slightly colored with Comp. tincture of iodine is then forced through the foramen with a fine-pointed syringe (Fig. 89) introduced well up the canal and surrounded with a packing of gutta-percha. The packing is best done by heating the point and surrounding it with the gutta-percha to better secure its adhesion. Or, the solution may be pumped up with cotton wound on a root-canal file the point of which has been removed, until it passes into the abscess and out through the fistula. This is followed by pumping through with a broach carbolic acid 95 per cent. or some other preferred agent. Aromatic sulfuric acid may also be injected through the foramen or the fistulous opening into the abscess a few times in cases that do not quickly respond to other treatment.



FIG. 89.

Abscess of the Second Form.—When calcification has caused the obstruction in the canal, enlarge the canal as far as possible with root-canal files, reamers and Gates-Glidden drills. Next, guided by the outline of the root and canal, as shown by a radiograph, with small-sized burs penetrate the calcified area. When the latter is accomplished, with a small, sharp-pointed round broach and sulfuric acid endeavor to make a passage to and directly through the foramen into the abscess, as the extreme apical section of the canal is not always entirely calcified. Placing a little of the acid in the extremity of the root to remain for two or three days will sometimes aid the operation. Drilling directly through the end of a root should be practiced only when other treatment fails, as the opening made seldom follows the line of the canal through the foramen.

Exostosis.—When exostosis closes the foramen, the root-canal should be sterilized and filled and the affected portion of the end of the root removed (see Apicoectomy) and the area of the sinus curetted.

Third Form.—In these cases first open, clean and disinfect the canal and enlarge the foramen with root-canal files, and serrated broaches, if necessary aided by sulfuric acid so that the largest size will pass freely into the abscess. Through the enlarged foramen, by aspirating and then gently injecting, wash out the abscess cavity at first daily with the saline solution or absolute alcohol or both, using a

sub Q or similar syringe with the smallest size gold point, gage No. 21 to 22, or pumping with cotton tightly wound on the point of a small root-canal file. In some cases the point of the syringe may be introduced through the foramen directly into the abscess cavity. Another syringe of the same style may be used by aspiration to withdraw the injections and contents of the abscess cavity by inserting the point with a packing up the root-canal and withdrawing the piston. In this way the injections may be repeated and withdrawn. The canals are next filled loosely with a dressing from which all excess of the fluid has been pressed with bibulous paper, of saturated solution of aristol and oil of cloves, eucalyptus or, preferably, oil of myrtol, if tooth discoloration is to be avoided. Insert a small probe in the canal, pack the orifice and cavity with gutta-percha, press on the gutta-percha and withdraw the probe. The aperture left by the probe furnishes a small vent. Continue this line of treatment until evidence of suppuration ceases, then temporarily pack the canal closely with the medicated dressing and seal the cavity, first with and later without a vent. After the lapse of several weeks or in some cases a much longer period should a radiograph show the indications to be favorable on removal of the dressing, close the foramen with a cone of gutta-percha, carefully avoiding pressure of air or excessive protrusion of the gutta-percha through the foramen.

If the abscess is only acute or small this method, if skilfully practiced, will usually effect a cure. Should this treatment fail, an opening through the membrane and alveolus into the abscess must be obtained and the same course pursued as described in the first form of abscess.

Alveoectomy.—For this operation the length of the root and position of the apex should first be accurately determined. This is done by the aid of a radiograph and introducing a broach with a hook point through the canal and foramen—if it is open—into the abscess and then slowly withdrawing the broach. In the withdrawal the hook by catching on the apex indicates both the position and the length of the root (Fig. 90). A little disk of heavy rubber-dam or a pellet of gutta-percha placed on the broach, as shown at A, will form an accurate gage. After the withdrawal of the broach a fine probe is passed up the canal through the foramen into the abscess and left there in position. The exposed portion (A, Fig. 91) will fairly indicate the direction in which the root points, and should there be no considerable curve towards the apex, the line in which the sinus is most likely to be found. The hook broach B is then placed externally with its shank exactly parallel with the probe A in the canal, and the line of the broach and more especially the location of the hook point, marked on

the gum with carbolic acid. A few shreds of cotton twisted around the broach, especially at the point, will aid in carrying and holding the acid.

In the manner described, aided by a radiograph, the line of the root and the position of the apex can generally be located and as well the sinus, which may be a little to the right or left of the apex. The membrane at the spot marked is then punctured and entrance to the apex of the root and apical space and abscess effected through the bone with a small spear-shaped drill and spoon-shaped excavators. The fine probe protruding through the foramen into the sinus will additionally aid the operator in locating sinus and root apex. The membrane may be anesthetized, preferably by conductive anesthesia, previous to the operation, or the operation may be performed under analgesia. Local hypodermic injections dilate the tissue, which is an interference with the operation.

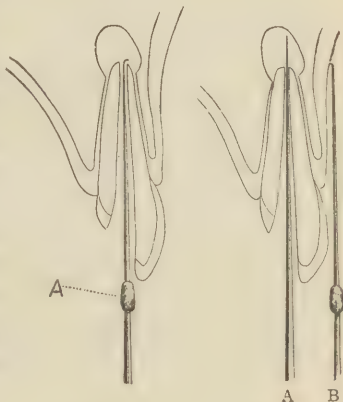


FIG. 90.

FIG. 91.

An entrance into the apical space can be made almost painlessly in the following manner, as described by Dr. G. V. Black: "The mucous membrane is first dried at the point at which it is desired to make the opening, and napkins are so placed as to keep it dry. Then a plugging instrument with fairly sharp serrations and of convenient shape is selected, the point of this dipped into a 95 per cent. solution of carbolic acid, and a drop conveyed to the mucous membrane; this will at once produce a white eschar. Then a slight scratching motion with the serrated point is begun, with the view of removing the tissue that is whitened. This is continued until the carbolic acid is thick with *debris* of the tissue torn up, then it is dried out and another drop added, as before, and the process continued. This is repeated as often as may be necessary, going deeper and deeper into the tissue in the desired direction until the bone is laid bare. Then a fresh drop of the acid is placed on the bone, and the periosteum carefully raised over a sufficient space; then with a sharp chisel or a coarse bur cut through to the peridental membrane. This will generally cause some pain and some hemorrhage, but after giving a little time for this to cease and adding more of the acid, the apical space can usually be reached without difficulty. No blood should be drawn at any time during the operation except in penetrating the walls of the alveolus. In doing this no tissue is re-

moved until it is anesthetized by the carbolic acid. This is a little tedious, but is almost painless, and the general affect is usually better than by other modes of penetrating the apical area. The carbolic acid has the effect of modifying the pain, and the opening left does not close so readily.''

A variation of this method is: after reaching the alveolus, instead of using more carbolic acid, press moistened pellets of adrenalin and cocain into the tissue. In this manner anesthesia is produced, sufficient for the operation, without dilatation of the tissues by injecting.

In these cases, curetting of the cavity of the abscess and apex of the root is most effective, but removal of healthy bone tissue should be avoided as much as possible, as the stability of the root and sometimes of the adjoining teeth is proportionately impaired thereby.

Thorough disinfection and sterilization of the root-canals and dentin are included in the treatment of alveolar abscess. This is best accomplished by saturating the dentin with a solution of oil of cloves and aristol until the dentin darkens in shade. As soon as the treatment is followed by favorable indications, the foramen should be closed with gutta-percha while the fistula is yet open, and the remainder of the canal filled with zinc oxychlorid as described on page 84. Any further treatment considered necessary can be conducted externally through the fistula. This may be facilitated by enlarging the orifice with tents of iodoform gauze and in very small places with iodoformed cotton or in cases of small abscesses cotton saturated with oil of cloves and aristol. Enlargement of the fistula tends to encourage the process of granulation in the region that has been occupied by the abscess, especially when a carious or necrosed condition of the bone required its removal.

Alveoectomy and filling of the root-canal in one operation without preliminary thorough removal of infection of the dentin is condemned by the author.

Aromatic sulfuric acid is a powerful astringent and germicide. It will be found most useful in cases where only a very slight carious state of the walls of the alveolus exists and does not indicate the necessity of curetting. Its use, however, should be limited and in subsequent external treatment through the fistula some of the other therapeutic agents may be employed, such as the essential oils or carbolic acid alone or combined with one of the preparations of iodine.

Injections of sulfuric acid in the region of the mental foramen should be made cautiously and should not be applied to an abscess bordering on the antrum until the operator is *positively* assured that the abscess does not open into that cavity.

Granuloma.—Granuloma is a tumorous growth around the apex or on the side of the root of a tooth. It is caused by inflammation and gradual hypertrophy of the pericementum, pus usually not being present. The treatment is removal of the tumor, curetting of the cavity in the alveolus and if indicated amputation of the affected portion of the apex of the root.

Apicoectomy, Amputation of the Apex of a Root.—In chronic alveolar abscess the pus cavity occasionally involves the alveolus in such a way as to destroy a considerable portion of the pericementum of the end of the root. The cementum of that part is consequently devitalized and the portion of the root affected becomes degenerated in structure and permeated with septic matter. In this condition it acquires the character of a foreign substance, proves a constant source of irritation and defies all efforts of the membrane to perfectly inclose or encyst it.

In such cases when curetting of the abscess cavity and end of the root has failed, amputation of the portion of the root which is denuded of pericementum is the best course to pursue. This also is the only treatment that can be resorted to in exostosis. An incision is made in the alveolar tissues sufficient to fully expose the affected part at least $\frac{1}{3}$ to $\frac{1}{2}$ inch in length. Any carious or necrosed bone in the territory is then curetted and the end of the root removed to the line of the curetted bone (Fig. 92). The dentin of the root having previously received antiseptic treatment, the upper portion of the canal is filled solidly with gutta-percha previous to the amputation so that when the end of the root is excised the stump will be left smooth and snugly filled.



FIG. 92.

The end of the root is best removed by first locating the apex and then trimming off the required amount with a fissure or rose-shaped bur. The instrument should be held at a right-angle to the line of the root in an apical direction to avoid a slanting amputation. The ground-off particles of the root are to be removed by injections of the saline solution into the cavity during and after the operation.

Gradual removal of the apex as described is preferable to cutting across the root with a bur, as the amputated part or parts are occasionally difficult to remove. When the required amount has been removed the ledge of the surface of the end should be slightly rounded and the surface smoothed with fine carborundum and gem points.

The orifice of the cavity in the gum should be kept open with iodoform gauze and douched daily for two or three days, then at intervals

of two days for four days and finally every three to four days, until the cavity is filled by granulation. In this method of treatment any imperfection in the operation will be evidenced by failure of the part to properly granulate and it can be corrected. When the sinus is not packed and external tissue is drawn over it with sutures or it is allowed to close itself, filling of the sinus with tissue is not as well assured. When the healing process is completed, crown-work may be proceeded with.

Apicoectomy is much simplified and often more effectively performed in cases where the apex is deeply seated by first disinfecting the root-canal, irrigating through the canal and fistula for a few days and pressing back the soft tissue with iodoform gauze to expose the portion of the root to be operated on. The preparatory treatment described simplifies the operation; as generally practiced the hemorrhage obstructs the view of the parts and renders liable the removal of an unnecessary amount of tissue, besides increasing the severity of the operation for the patient.

An Apilocater

In operating to locate and reach the root apex in cases where the area of focal infection and sinus is small and the tissues present no abnormal appearance externally, when the radiograph and root-canal exploration indicate that the root apex is located deeply in the bone, considerable normal tissue is frequently removed.

The apilocater is an instrument to definitely locate a root apex so that direct entrance may be obtained to it through the bone. The hole made may not be more than is necessary to effect a drainage or vent such as is formed with a No. 20 gage drill. This hole once established can then be enlarged to any required size.

Figure 93 portrays in section an apilocater applied to a left superior cuspid, and Fig. 94 the instrument removed from the tooth.

A, Fig. 93 is a large smooth broach with a dull point inserted up the canal and through the foramen. B, the shank end of the broach secured in the broach holder by slipping it over the shank of the broach with the tapered end of the broach holder resting against the tooth, and held in position by tightening the ring screw C. This defines the length the broach is inserted through the canal and the distance beyond the root apex it penetrates. The broach and holder are then removed. To accurately secure the same position for the instrument when it is replaced on the tooth, a small pellet of softened impression compound is placed around the shank of the broach and on the point of the holder at H, Fig. 94, the instrument is returned to its position on the tooth,

using the necessary pressure, and the compound chilled. The instrument is then again removed. The compound forms an impression of the part of the tooth the holder rests against which will accurately define the position the broach and holder are to occupy when again replaced.

The arm D, Fig. 93, again shown at E, Fig. 94, is next adjusted in position on the shank of the broach holder against the ring screw, and secured by the screw G.

The section of the instrument shown at I, a flat adjustable bar with the large slot J, is next adjusted on the arm E, in such position that the

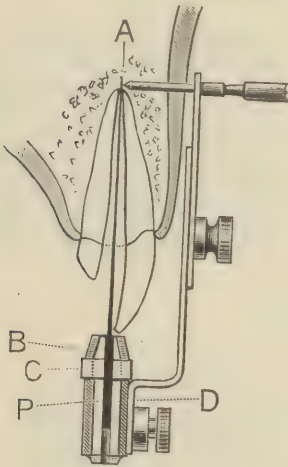


FIG. 93.

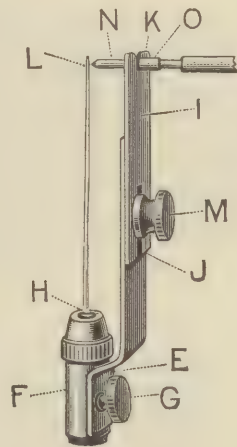


FIG. 94.

small notch K, at the free end of the bar is located on a line at a right angle to the broach point L. The bar I is then fastened in this position on the bar E, by the screw M.

The spear-pointed drill N, is next positioned in the notch K, at a right angle to the broach point L, the ferrule O, is warmed to soften the cement that attaches it to the drill and the ferrule is adjusted to the side of the flat bar I, at the notch K. The edge of the ferrule defines or gages the distance the drill has to enter to reach the root apex and area of infection. The drill is then removed.

To operate the instrument the broach is inserted up the canal with the other parts in position, as shown in Fig. 93. The shank of the drill N, is inserted in the hand-piece of the dental engine and the drill in notch K, at a right angle to the line of the broach point and flat bar I, with the point of the drill touching the surface of the gum. Driven by the dental engine the gum and bone are penetrated by the drill until the edge of the ferrule on the shank touches the surface of the extension

bar at the notch K, Fig. 94, which indicates that the drill point has penetrated to the located area of the root apex. The drill is then withdrawn and a small probe with a hooked point is introduced through the drill hole to explore for and engage the broach point protruding through the foramen, as shown in Fig. 95, and thus positively determine whether the drill has reached the broach and a passage or vent has been established. If the broach point is not discovered by the probe,

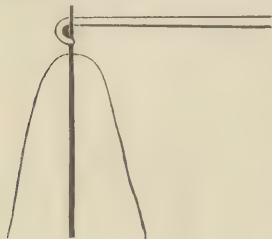


FIG. 95.

which is frequently the case when the root or its apex is curved, also when the drill has not been accurately directed, a small hoe-shaped excavator or similar instrument is introduced, the bone excavated and the adjacent area explored until the point of the broach is discovered. If necessary to aid and facilitate the insertion of the excavator, the hole made by the spear-shaped drill is to be enlarged with a smooth-bladed round or

fissure shaped bur. When the broach point has been reached irrigate through the canal to fully establish the fact.

The amputation of the apices of roots requires skill and experience and had better be confined to the anterior teeth or those with a single root, except in the hands of experts.

Hydrogen Peroxid.—Hydrogen peroxid should not be used in the treatment of alveolar abscess except where there is a large vent for its free expansion, and even then its use is viewed by many with disfavor, as it destroys granulation. In inclosed or partly inclosed areas, it is liable to distend existing infection. In cases having a large vent, immediately subsequent to the use of aromatic sulfuric acid, hydrogen peroxid may be used, as then its expansion will be slight.

Prognosis of Chronic Alveolar Abscess and Apicoectomy.—Roots affected with chronic alveolar abscess, the pus sac of which is in the line of the apex of the root and involves only a small portion of the alveolus, can be considered as suitable for treatment and crowning operations. When the area of pus has extensively destroyed the pericementum at the apex and also on one or both sides of the root, proportionately to the loss of the pericementum is the root to be judged as impaired. In alveolar abscess and exostosis the removal of one-fourth of the length of the root is as much as shows a proportion of success that justifies the operation. In cases of very long roots, the removal of one-third may be favorably considered. A, Fig. 96, is a radiograph of a case before, and B, just after an operation. C and D are respectively two and five months later.

An amputated root should not be used as a support in bridge-work, although it may be included in a bridge supported by adjoining abutments.

Perforation of a Side-Wall of a Root-Canal or of the Dentin at the Bifurcation of the Roots.—Extensive perforation by decay through the side-walls of the root-canal of a tooth considerably below the line of the edge of the alveolar process seldom permits of successful treatment. After removal of the decay, if only a very slight perforation exists or if the perforation has been made by the improper or careless use of a bur,

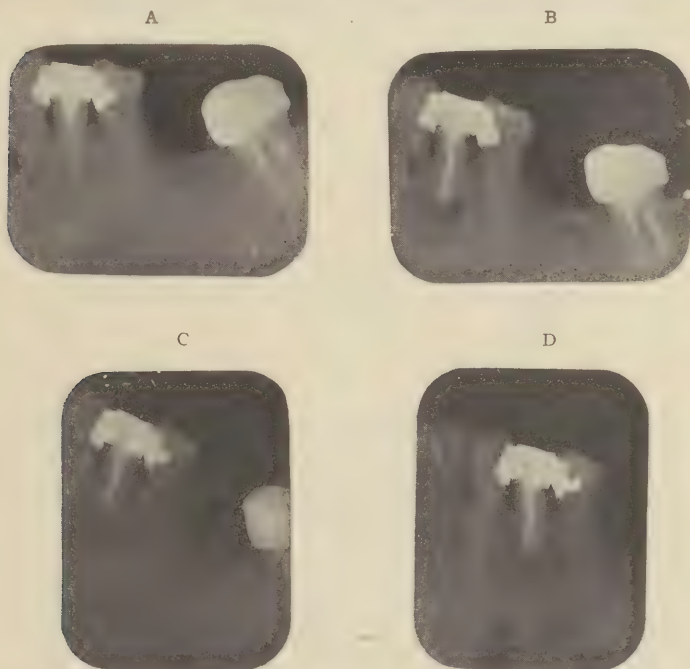


FIG. 96.

cicatricial tissue may be induced to form over the part by creating and maintaining a sterilized condition and then sealing the aperture.

The method of procedure is as follows: First effect sterilization of the dentin and canals and fill the canal beyond the perforation. Next apply adrenalin and cocain to stop all hemorrhage and when the hemorrhage has ceased, wash and syringe the canal with absolute alcohol. Dry the canal thoroughly and fit closely over the perforation a small flat piece of gutta-percha, or gutta-percha cement, warmed and applied with a gentle pressure, sufficient only to produce adhesion without

forcing the gutta-percha through. The filling of the canal can then be carefully completed, using silver chlorid cement. If this method proves unsuccessful and inflammation ensues, the position of the perforation, aided by a radiograph, should be carefully calculated and an artificial fistula formed on a direct line with it through the gum and alveolar process, Fig. 97. Carbolic acid may be used to obtund the tissue in forming the fistula as already described, or a novocaine injection be administered. The necessary perforation through the alveolar process should be small in diameter and be made with a drill. Frequently the position for the intended fistula is best located by introducing a sharp-

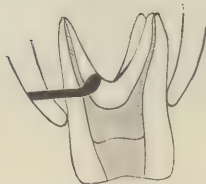


FIG. 97.



FIG. 98.

pointed curved probe into the canal and perforating externally through the tissues. Injections can then be made outward through the fistula and the perforation sealed with gutta-percha, similar to the closing of the foramen in cases of alveolar abscess.

The incisors and cuspids are frequently perforated through the side of the root-canal by the unskilful use of drills or burs. In such cases the perforation is generally caused by holding the hand-piece of the dental engine out of the line of the axis of the tooth, as shown in Fig. 98 and illustrated and described on pages 114, 115.

The result of the treatment of a perforation should be well determined before proceeding with an operation on the root or tooth.

PART III

CHAPTER I

ARTIFICIAL CROWN-WORK

First Authentic Account of Artificial Crowns or Pivot Teeth.—The first authentic account we have of the use of artificial crowns or pivot teeth is given by Fauchard, in his work entitled "*Le Chirurgien Dentiste ou Traités des Dents*," in 1728. Fig. 99 illustrates the crown he describes. The root was filed level with the surface of the gum, the root-canal enlarged, cleaned and filled with lead. A hole was drilled in the lead and the rough-surfaced post was forced into the soft metal to secure it. The other end of the post was fastened in the crown, which was either a natural crown or one made of ivory.

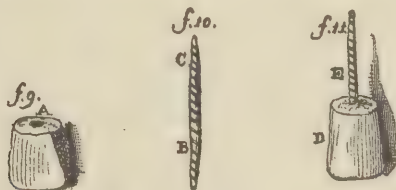


FIG. 99.—Fauchard's "dent a tenon."

De Chemant describes the use of porcelain for the construction of pivot teeth in the early part of the last century. From that time on porcelain has been used and has gradually, for the most part, superseded other materials for the construction of crowns.

The First Porcelain Pivot Teeth.—The porcelain pivot tooth or crown, Fig. 100, was the form used for many years. When first introduced it was attached to the root by means of a hickory-wood pin or pivot, one end of which fitted the hole in the center of the crown and the other that of the root-canal. The moisture of the mouth by swelling the wood fastened the pivot in both tooth and root.

It was found that the wooden pivot in time caused decay of the root, was liable to fracture it by expansion, and it also affected the breath. These objections led to the introduction of the use of the gold pivot.

Gold Pivot Teeth.—Gold pivots in the early days of their use, were variously secured to root and crown. In the crown the pivot was fastened by incasing it with wood or by skilfully flowing a little gold solder around that part of it which set in the porcelain, and to the root by fitting in the canal a piece of hickory and inserting the pivot in the wood or by twisting fibers of cotton or silk around the post and pressing the crown to position.

First Porcelain and Gold Tooth or Crown.—The porcelain pivot tooth mounted by these methods was superseded by the use of a plain-plate porcelain tooth backed with gold and soldered to a piece of plate stamped out to accurately fit the end of the root and soldered to the pivot or pin, as shown in Fig. 101. A later improvement in the attachment of the crown consisted in tightly fitting the pivot into a gold

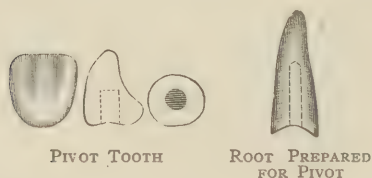


FIG. 100,



FIG. 101.

tube screwed into the root. This latter method was devised to avoid the objectionable features connected with the use of wood. The transition from this last mentioned method to those of modern crown-work, though most important in their results, is not so marked as regards constructive details.

The Richmond Porcelain and Gold Collar Crown.—The gold collar crown with porcelain facing of present use is practically the gold backed pivot tooth of former years with the addition of a collar; though apparently simple to conceive, it was slow of development. It was not until such a form was presented and its advantages demonstrated by Dr. C. M. Richmond, about 1876, that its true value and possibilities were appreciated, more especially respecting the support it was capable of affording in bridge-work operations.

The Earlier Operations.—The earlier operations in porcelain crown-work were almost entirely confined to the incisor and cuspid teeth, the object being restoration for appearance rather than utility. We find, however, on investigating the history of the art, that some effort was also made by a few of the earlier practitioners to maintain and restore the usefulness of affected posterior teeth with crown-work. Prominent among these was J. Paterson Clark, a dental practitioner in London,

who, as early as 1836 published a description of his method of restoring decayed and abraded molars to usefulness by covering them with gold caps stamped up on a metal die of the tooth.

The Morrison and Beers Gold Crowns.—Similar operations were described and practiced later on in this country by Dr. Wm. H. Dwinelle,¹ who in 1855 related the method for the application of a crown with a porcelain facing, and Dr. W. N. Morrison,² in 1869, and were brought into more prominence by Dr. J. B. Beers,³ who in 1873 secured a patent for his method of capping teeth with gold, as illustrated in Fig. 102.

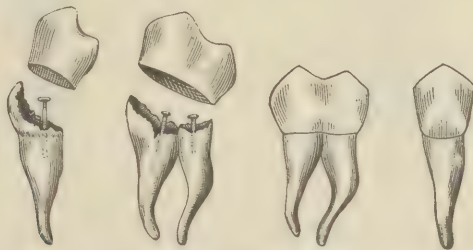


FIG. 102.

During the progressive modifications in crown-work which evolved from the gold pivot tooth or crown to the gold collar porcelain crown of the present time, many improvements on the original porcelain pivot tooth as a ready-made crown were developed and introduced into practice. One of the first of this character to attain prominence was the Foster Crown.

The Foster and Lawrence Crowns.—The Foster crown introduced by Dr. E. W. Foster, in 1855 and so named, although similar to one patented by Dr. H. Lawrence, in 1849, differed from the commonly used pivot tooth in having a perforation in the center of the palatal side on



FIG. 103.

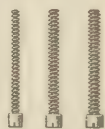


FIG. 104.

a line with the root-canal. The orifice was shaped to accommodate the head of a screw (Figs. 103 and 104) by which the crown was attached to the root. The object of this form was to dispense with the use of wood as a pivot or post.

¹ *American Journal of Dental Science*, April, 1855.

² *Missouri Dental Journal*, May, 1869.

³ *Circular to the Dental Profession*, 1873.

The Mack and Howland-Perry Crowns.—The first form of porcelain crown introduced which protected the end of the root by the use of cement for its attachment was devised by Dr. C. H. Mack, in 1872. It consisted of a hollow porcelain crown with a cavity in the base of a shape and size to admit the extremities of pins screwed into the root or cemented in the canal. The crown was cemented on the root over these pins with gutta-percha, amalgam or zinc oxychlorid. The



FIG. 105.



FIG. 106.

Mack crown proved unreliable in practical use because of the insecurity of the attachment. The Howland and Perry crowns, which were so nearly identical that they became known as the Howland-Perry crown (Figs. 105 and 106), improved on the Mack by imparting to the cavity in the base a better form for the retention of the screws in the cement and a more suitable curve to the base.



FIG. 107.



FIG. 108.

The Gates-Bonwill Crown.—The next notable improvement in all-porcelain crowns appeared in the Gates and Bonwill crowns, the former being the invention of Dr. W. H. Gates, about 1875, and the latter of Dr. W. G. A. Bonwill, in 1881. These also were so nearly alike that they were called Gates-Bonwill (Figs. 107 and 108). One of the advantages this crown possessed over the Foster was that amalgam was used for its attachment, thus protecting the end of the root from decay. The base of the crown was concave and the aperture for the post of a triangular form. The crown was secured to the root with a screw post, or a flat pin with tapering ends, anchored with the amalgam

that attached the crown. This crown was extensively used for several years.

The How Crown.—The How crown (Fig. 109) was invented by Dr. W. S. How, in 1883. Its novel feature was the formation of a sufficient concavity in the palatal side of the incisors and cuspids to afford space for four pins in the porcelain, with room between them for the adjustment of the screw post. The crown when fitted was attached

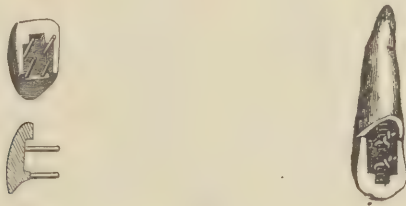


FIG. 109.

by bending the pins around the post and packing around them and filling the cavity of the crown with amalgam.

The Weston Crown.—The Weston Crown, introduced by Dr. Henry Weston about the same time, was similar in principle and structure, with this difference: The Weston post was flat and riveted to the crown before insertion. The post was first cemented in position with a small quantity of zinc oxyphosphate and the remainder of the space

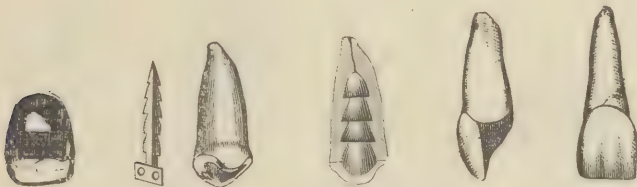


FIG. 110.

then filled with either gold or amalgam. Fig. 110 shows the various steps in the operation.

The Brown Crown.—Another form of modern introduction but limited use was the Brown crown, illustrated in Fig. 111. It was made with a conical base and with a long post baked in the porcelain. In mounting it the end of the root was concaved to receive the convex porcelain base. The object of this form of construction was to permit the porcelain to be removed in a close "bite" without materially weakening the crown.

The New Richmond Porcelain Crown.—In the New Richmond porcelain crown, illustrated in Fig. 112, which was also of the all-porcelain variety, a V-shaped cavity was provided at the base to exert some degree of lateral pressure on the root and thus help to guard against its fracture.

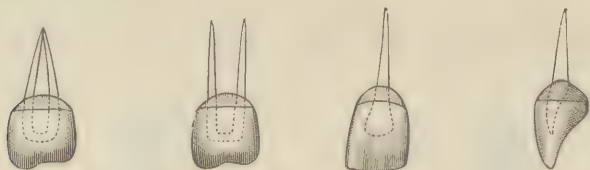


FIG. 111.

The Logan Crown.—The Logan crown, formerly so extensively used, was invented by Dr. M. L. Logan. Its distinctive features are the cupping out of the base surrounding the strong platinum post, the form of the post, and the baking of the post in the porcelain. As originally made the post was round, but shortly after the tapered I-beam post was introduced. Fig. 113 shows the Logan Crown in section.

The development of what were classed as ready-made porcelain crowns as here traced, brings us to the forms which are now in use and which will be described in the succeeding chapter.



FIG. 112.

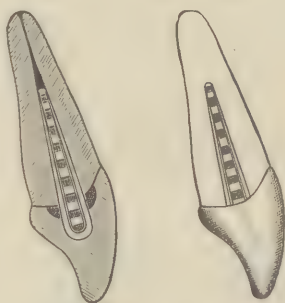


FIG. 113.

Advantages Conferred by Improvements in Cements.—Doubtless much of the present perfection of methods by which the effective results now achieved in this branch of dental prosthesis are made possible, is due to the use of cements with which the ends of roots and crowns are hermetically inclosed. Of these the first was zinc oxychlorid, introduced about 1860, though not used in this work till some years later. More important was zinc oxyphosphate, first made known about 1877, while a better understanding of the properties of gutta-percha as applied to this purpose has contributed not a little to the results.

Classification of Modern Crown-Work.—Modern artificial crown-work affords extensive facilities for restoring the crowns of natural teeth and furnishes means of support for bridge-work.

In the consideration of modern crown-work presented in the succeeding chapters the subject is divided into two general systems.

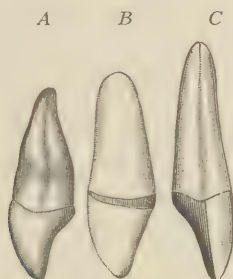


FIG. 114.

The first system will include post or dowel crowns without a collar or ferrule, namely: All-porcelain—Detached-post crowns (A, Fig. 114); All-porcelain detached-post crown mounted on a metallic base (B); Porcelain-faced gold crown with gold backing and base (C).

The Second System will include such methods in crown-work as are illustrated in Fig. 115, in which collars, bands or ferrules as variously designated, are used to partly or entirely encircle the cervix in

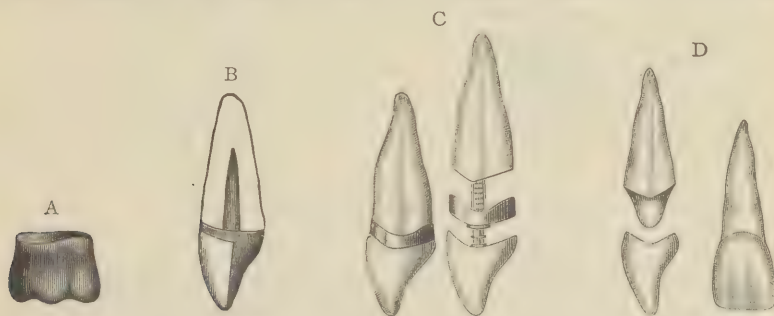


FIG. 115.

crowning operations, namely: all-metallic collar crown (A); collar crown with porcelain facing (B); detached-post crown on capped root (C); porcelain jacket crown (D) and various styles of combined metal and porcelain crowns.

Following the descriptive details of these two systems partial crown or inlay-work and special operations in crown-work will be described.

CHAPTER II

PRINCIPLES INVOLVED IN CROWN-WORK

Nomenclature of Crown-Work.—To systematize and explain the nomenclature used in the descriptive details of crown-work, the following definitions of terms used are given (See Fig. 116):

- | | |
|--|---|
| 1. Apex. | 19. Plate, coping, or cap. (This part when a collar is used is termed the floor.) |
| 2. Cervix. | 20. Slot between cap and base of porcelain facing. |
| 3. Cervico-lingual surface. | 21. Back of porcelain facing. |
| 4. Cervico-labial surface. | 22. Metallic backing. |
| 5. Labial surface. | 23. Metallic backing on incisal surface. |
| 6. Lingual surface. | Incisal backing. |
| 7. Incisal end. | 24. Post, dowel, pin, or pivot. |
| 8. Occlusal, occluding, or grinding surface. | 25. Base of crown. |
| 9. Lingual cusp. | 26. Collar, band or ferrule. |
| 10. Buccal cusp. | 27. Cervical edge of collar or crown. |
| 11. Sulcus. | 28. Occlusal edge of collar. |
| 12. Root-canal. | 29. Occlusal cusps or grinding surface. |
| 13. Surface of end of root. | 30. Occlusal third of a tooth. |
| 14. Labial or buccal section of end. | 31. Middle third of a tooth. |
| 15. Lingual section of end. | 32. Cervical third of a tooth. |
| 16. Post, dowel, pin, or pivot. | |
| 17. Point of post. | |
| 18. End of post. | |

Mesial side, towards the median line of the mouth.

Distal side, from the median line of the mouth.

Cavo-surface, the cavity or inside surface of a cap, crown or inlay.

Pontic, an artificial bridge tooth between abutments; a dummy.

Mesial-occlusal or distal-occlusal inlay or attachment, one that covers only those parts.

Mesial-occlusal-distal attachment, an attachment covering only those parts.

Mesial-occlusal-distal-lingual attachment. An attachment covering only those parts and not the buccal surface.

Lug, a projection of metal that either rests on a tooth, artificial crown or inlay, or fits into a socket formed in them. Also termed a spur or flange.

In whatever form teeth and roots are presented for crown-work, invariable scientific and mechanical principles govern the application,

although the style or method of construction admits of selection. The general condition of the roots or teeth to be operated upon and the character, direction, and force of the occlusion are subjects that govern the *application*. The location in the mouth and the object of the operation indicate the preferable style or method of construction. Operations on the eight anterior teeth will generally be influenced by appearance and those on the posterior teeth principally by utility.

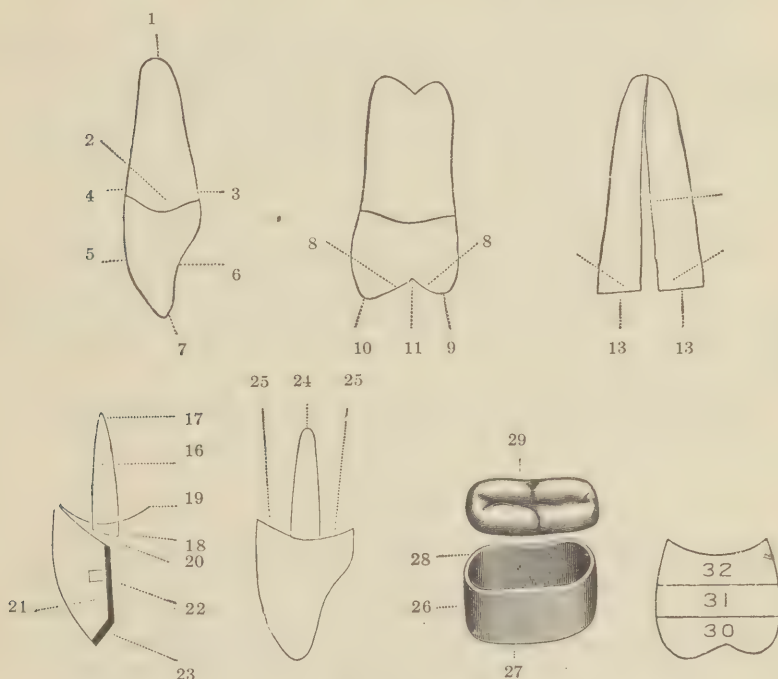


FIG. 116.

The Object of Crowning Operations.—Crown-work ordinarily is classed in tooth conservation as a resort subsequent to the failure of filling. In the crowning of roots and pulpless teeth having the coronal section practically destroyed by decay, protection against its recurrence, fracture of the root and restoration of normal contour are the subjects to be especially considered. In cases where sound teeth, or teeth with or without living pulps, only slightly decayed, are to be capped with gold as supports for bridges, the work is to be conducted principally with a view to the preservation of the coronal sections as well as their utilization as abutments.

Requirements in Crown-Work

Physiological Relations.—Preliminary to a crowning operation a careful examination should be made of the investing and surrounding membrane. Any existing pathological condition should be carefully examined and the parts radiographed. Should a pathological condition exist the diagnosis of which as well as the prognosis is favorable, treatment should be applied and a favorable result assured before crown-work is commenced.

Anatomical Relations.—Anatomical reproduction of the normal tooth form on all the surfaces as far as the conditions in the case will permit, is a necessity in modern crown- and bridge-work, as normal tooth form is the basis of physical benefit to be derived, as well as of nature's protective influence over investing membranes. (See Figs. 127 to 135 inclusive.)

Imparting anatomical form to the approximal sides of crowns in their construction provides the V-shape spaces so essential for the gum septa, furnishes protection on the labial and buccal sides to the gingival tissue, is esthetic in effect; and the contour given the lingual side restores the natural shape, which is the one most agreeable and suitable for the tongue.

Correct reproduction of the occlusal surface and of the peripheral walls distributes the force of occlusion proportionately.

Occlusion

Anatomical occlusion in crown-work is a basal requirement, as it influences the future health, efficiency and permanency of the teeth crowned. The principle of the occlusal planes should be kept well in mind, and as much as possible followed. Incisal edges and occlusal surfaces with their sulci should be formed and placed as nearly anatomically correct as the occlusion of the antagonizing teeth will allow or alteration of their surfaces permit. Unevenly applied or excessive occlusal pressure attributable to faulty construction is conducive to lesion of the periodental membrane, of the crowned teeth or roots or their antagonists.

Approximal Contact.—The knuckling of adjacent occlusal surfaces the one to the other is absolutely demanded. When imperfectly performed, invasion and pressure of particles of food in mastication are liable to occur, which is more or less injurious to the gum septa and productive of disease of the pericementum.

In a normal state of occlusion of the teeth the force of mastication is received in an upward outward direction on the lingual and incisal

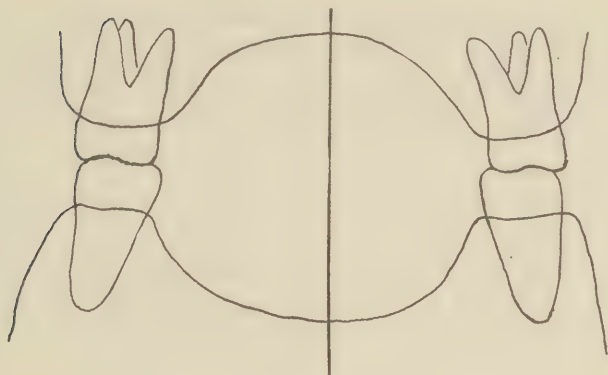


FIG. 117.

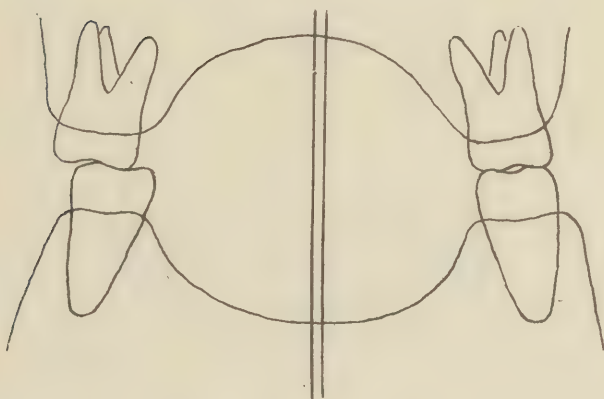


FIG. 118.

The lateral movement usually is not more than here represented.



FIG. 119.



FIG. 120.

surfaces of the six upper anterior teeth, and inwardly in an opposite direction on the incisal and labial surfaces of the corresponding lower teeth. When bicuspid and molars are evenly occluded the force is direct (Fig. 117); in a side or lateral motion of the mandible the



FIG. 121.



FIG. 122.



FIG. 123.—Viewed from the lingual side.

force is delivered in the corresponding direction against the occlusal surfaces of the cusps (Fig. 118). This lateral force upon the cusps in mastication is proportionately greater when the cusps are long, as in Fig. 119, and it can be modified by giving them the entirely practical

but shorter form with shallow sulci, illustrated in Fig. 120. This result can usually be accomplished without injuriously affecting the appearance, and the work can be materially simplified by a proportionate reduction of the cusps of the natural antagonizing teeth.

As the cusps of the bicuspid and molars retain them in proper alignment with their antagonizing teeth, they should always be formed to accord with an outline of the original shape of the natural teeth. Figs. 121, 122 and 123 illustrate normal occlusion of the natural teeth.

Malformed Occlusal Surfaces.—Fig. 124 shows an upper bicuspid crown with a malformed occlusal surface of a shape often improperly given in a case of close occlusion.



FIG. 124.



FIG. 125.



FIG. 126.

The result in time is that the crown and root, because of the gliding pressure exerted on the surface of the crown, are pressed outward so that the stability of the root and usefulness of the crown are gradually impaired and finally destroyed. In a case where the symmetry and appearance imperatively demand such an extension of the labial cusp, the displacement just referred to will be prevented by giving sufficient length to the lingual cusp to lock the crown in the act of occlusion, as shown in Fig. 125. This principle may be advantageously applied in the construction of crowns for the six anterior teeth, especially the cuspids, when, owing to the loss of the posterior teeth, they have to bear the force of occlusion. A slight shoulder or partial cusp will materially lessen the effect of the outward gliding pressure, Fig. 126 (see page 303).

Median Line of Natural Crown and Root.—In the treatment of root-canals and especially in the adjustment of incisor and cuspid arti-

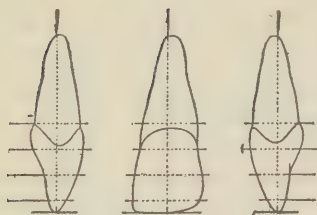


FIG. 127.

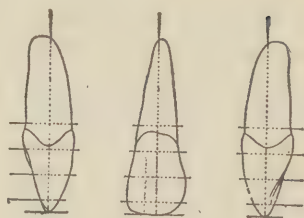


FIG. 128.

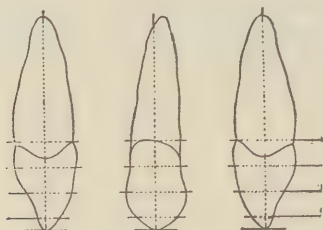


FIG. 129.

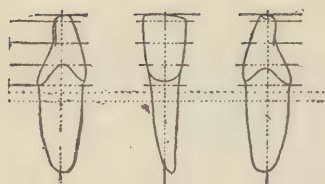


FIG. 130.

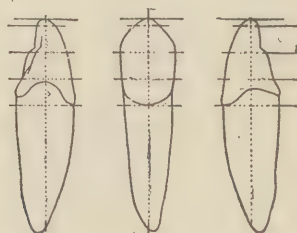


FIG. 131.

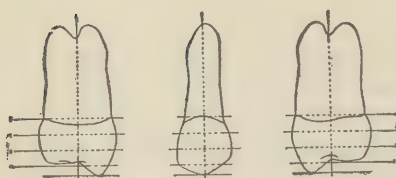


FIG. 132.

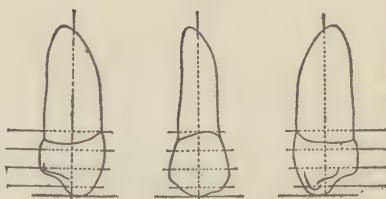


FIG. 133.

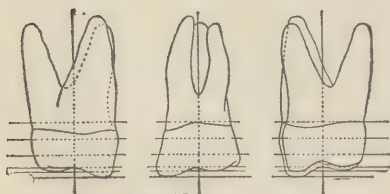


FIG. 134.

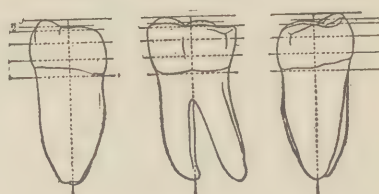


FIG. 135.

ficial crowns or teeth, the operator should be guided by the fact that the center of the line of the incisal surfaces and cusps is always located in the median line of the combined natural crown and root, as is shown in Figs. 127 to 131.

The Post in Relation to Canals and Roots.—The original forms of the canals and roots of the teeth should be studied and kept well in mind in reaming the canals for the reception of posts. The pulp-canal is located in the central section of each root; in the incisors and cuspids very nearly on a straight line between the apex of the root and the center of the incisal edge or cusp. (See Figs. 127 to 131.) This fact will materially aid in determining the direction or angle at which a drill, bur or reamer should be introduced into these teeth. The same principle may be considered in the conduct of operations on superior bicuspids, inferior first bicuspid, the buccal roots of superior first and second molars, and the mesial roots of inferior molars, making due allowance for such curve of the root as may exist, should the instrument be introduced deeply into the canal. (See Figs. 132 to 135.) When the natural crown of a root in normal alignment with the other teeth has been nearly or entirely lost, the angle to give the instrument may be calculated by the adjoining teeth and a radiograph.

The reaming should be so conducted that while the necessary enlargement is effected, the root is weakened the least possible.

Strength is most required on the approximal sides of the upper and lower six anterior roots, as the pressure imparted by the post in the canal is almost entirely received in either a lingual or labial direction. Proper reaming of the canal in accordance with its original shape and that of the cervical section of the root and the forming of the post to correspond will provide the greatest proportionate strength for both root and post.

As the most strength in a post is developed in the line of its greater diameter, a properly adjusted post that inclines to an oval form for the incisors and especially the cuspids will afford greater strength than a round one composed of the same quantity of metal. Fig. 136 outlines a cuspid root and oval-shaped post.

Tapering the post allows it to be introduced deeper into the canal without excessive reaming than if it is made of a uniform diameter or only rounded at the point. The point of the post, whatever the shape, should be immovably fitted or anchored in the canal, especially when the remaining portion fits loosely, as shown in Fig. 137.

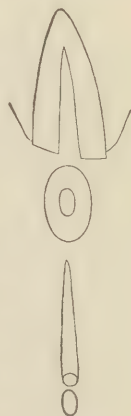


FIG. 136.

Anchoring the point deeply into the canal defines its position and lessens the liability of fracturing the root under pressure.

When the point of a post is not anchored, as shown in Fig. 138, but merely cemented with gutta-percha, crown and post are likely to tilt under continued application of pressure, as seen in Fig. 139. A weak or thin post is liable to bend, as illustrated in Fig. 140. Each of these conditions causes fracture of roots carrying post or dowel crowns, or of crowns with very small or improperly adapted posts and partial collars.



FIG. 137.



FIG. 138.



FIG. 139.



FIG. 140.

The Post in Relation to Post or Dowel Crowns.—A post or dowel crown without a collar is dependent entirely on the post or dowel for attachment and support. In this function the post exerts and resists in its encasement and foundation—the root—all the lateral and direct pressure incident to mastication. The length, shape and size of a post should therefore be regulated accordingly. A post in a root distributes applied pressure its entire length along the walls of the canal; consequently in the use of a long post a proportionately greater area is involved than with a short one.

Short and Long Crowns.—The greater the distance from the end of the root the force is exerted, the greater the proportion of lateral strain the walls are subjected to. Therefore the shorter the crown the less is the leverage or pressure. This principle is made clear by Fig. 141. The incisal edge of the crown which ends at A, will not exert through the post so great a proportion of pressure on the root in mastication as one with an incisal edge at B, which again would exert less pressure than one that extended to C. The latter would especially suggest the use of a long post.

When the occlusion of the six anterior teeth is deep and close, as shown in Fig. 142,—a condition termed “close bite,”—the crown and teeth or crowns as they occlude exert an increasing gliding pressure. An occlusion of this character always demands the largest and longest

possible close-fitting canal post. In occlusions occurring nearer the incisal surface, termed "open bite," as seen in Fig. 143, the pressure is more direct and proportionately less lateral in character.



FIG. 141.



FIG. 142.



FIG. 143.

Principles Governing the Construction of Root-Caps without Collars.

A cap, plate or cope as variously designated, without a collar, fitted to a flat or slightly curved end of a root does not afford a positive resistance to lateral pressure in supporting a crown. This resistance, however, can be quite effectually accomplished for the cap by giving a deep curve to the surface of the end of the root at the lingual side, or both labial and lingual sides combined—as resistance requirements suggest—which will be proportioned to the length of the post. The radius or distance from the point of the post to the margins of the curved or convex surface of the end of the root must be less than from the point of the post to the surface of the center of the end of the root. Consequently, the shorter the post, the deeper the labial and lingual edges of the curve should extend. The principle is demonstrated in Fig. 144.

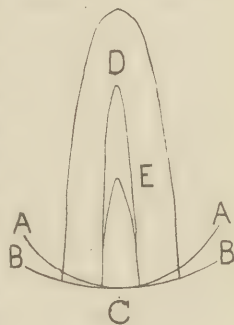


FIG. 144.

C is the center of the root end; D a long post and E a short one. BB is a segment of a circle described from D and AA a segment of a circle from E. The beveling or curving of the root end should be extended beyond BB for a post like D and beyond AA for a post like E.

Posts in Relation to Collar Crowns.—In collar crowns, as the end of the root is encompassed by the collar, the principal use of the post is to retain the crown. The actual length and size of the post required for

a collar crown is dependent on the conditions presented. Deep, substantially fitted collars require the aid of only a moderate post. Narrow or partial collars when applied to the six anterior teeth require proportionately larger posts for the crowns, approximating in size to those used for the ordinary post or dowel crown.

The force of occlusion being distributed over the entire occluding surface of bicuspid and molars, when a collar is applied it should entirely encircle the root. Crowns on these roots are therefore not so dependent for security on posts as those placed on the six anterior teeth. A substantial properly fitted and cemented post in any root-canal, whether or not attached to the artificial crown, always materially strengthens the root.

Selection of Porcelain Teeth.—Crown- and bridge-work is a branch of dental prosthesis which requires judgment and skill in the selection of porcelain teeth for the work in hand, as one of the great objects in dental art should be to conceal art. In a large proportion of operations on the anterior teeth, the result must be studied generally as much with reference to appearance as to utility. In size, form and shade porcelain teeth selected for one side of the mouth should match the corresponding natural teeth on the other side as nearly as the existing shades on the side treated will properly permit. The shade should be fully as dark, never lighter. Uniformity in shade of the different teeth should be avoided. Central incisors usually require to be the lightest in shade, laterals slightly darker, the cuspids darker than the laterals, and the bicuspid about the shade of the laterals. The shades of the lower teeth vary in the same order but are a little darker. Observation of this rule in selection will avoid that extreme sameness of shade so characteristic of artificial teeth, and cause them to more closely approach natural teeth in appearance. The proper and successful performance of crown-work operations depends largely upon the due observance of the principles here presented.

Dependence of Crown-Work Operations on Asepsis.—Crown-work in the restoration of badly decayed pulpless teeth or roots is intimately associated with their treatment, more especially as regards the establishment and future maintenance of a state of asepsis. The usefulness of operations depends on the successful assurance of this condition. Recent investigations show conclusively that ordinary infection of pulpless teeth and roots occurs mostly from the oral cavity. It is therefore clear that root-canal filling and such restoration of any portion of the natural crown present as may be required preparatory to capping should be so conducted as to offer the greatest possible obstruction to infection from that source.

CHAPTER III

SHAPING TEETH AND ROOTS FOR CROWN-WORK

Local Anesthesia.—The shaping of roots or crowns of teeth for crowning operations does not necessarily call for the use of general or conductive anesthesia. In the proper conduct of the operation the local application of anesthetic agents is usually sufficient. Anesthetic agents so applied affect the gingivæ and investing membranes but not materially the dentin. The dentin of pulpless roots or teeth does not require desensitizing, and in cases of teeth with vital pulps desensitizing is either not desirable or only permissible to a limited extent. When teeth are so sensitive as not to permit proper preparation, or become so during the operation, pulp removal is suggested to avoid subsequent lesions. Under general and conductive anesthesia the operator is unaware of the exact extent of the sensitiveness developed, but after the anesthesia has passed the patient becomes conscious of it and often annoyingly so. In the use of local anesthesia the same care should be exercised to avoid injury to the investing membranes as though sensation were present.

Adrenalin and Cocain.—Tablets No. 151: Cocain hydrochlorid $\frac{1}{6}$ grain, Adrenalin $\frac{1}{300}$ grain (Parke, Davis & Co.), is a prompt and effective agent for local anesthesia. The tooth to be operated on is protected from the saliva with cotton rolls. One or two tablets are broken into small pieces and carried with the point of a thin spatula, or other suitable instrument, well under the free margin of the gum entirely around the root or tooth. The moisture present under the gum is generally sufficient to dissolve the tablet and retain it in position; if not, dampen the point of the instrument by dipping it in water. Protect the tooth from the saliva for two or three minutes, then remove the cotton rolls and have the patient rinse the mouth instantly. In this manner the action of the cocain is mostly confined to the spot where it is applied, without other unpleasant effect.¹

¹ The author has used this agent, as described, for many years and has never experienced any result unpleasant enough to record.

For Conduction Anesthesia, see "Materia Medica," Prinz, 4th Edition.

Instruments Used.—Carborundum wheels, such as are illustrated in Fig. 145, are used to grind down occlusal surfaces, portions of teeth and ends of roots. Thin disks of vulcarbo, straight side or curved, as shown in Fig. 146, are for cutting the approximal sides. Points seen in Fig. 147 are for trimming around the sides of crowns at or close

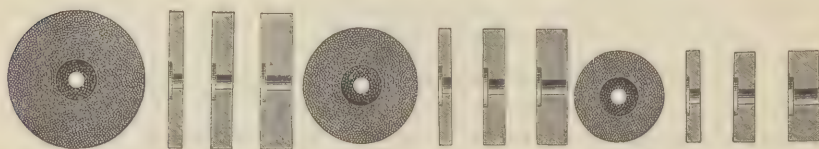


FIG. 145.

to the cervix. The wheel-shaped forms in Fig. 147 are for trimming such parts of the crown or root as they can reach. Many of the smaller points may be used to advantage in the angle attachment to reduce parts that cannot be well reached by them when in the straight hand-piece. Trimmers of the shapes and sizes illustrated in Fig. 148, made with cross-cut serrations in the straight or angle handpiece are serviceable for rounding corners and trimming the cervices of roots. Fig.

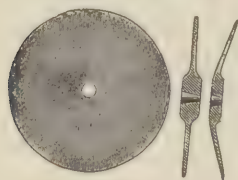


FIG. 146.

149 illustrates a triangular point that can be made of an engine bur tempered very hard, each of the edges of which can be used as a scraper in a hand socket, bracing the hand by resting the thumb on the adjoining teeth. Files and serrated scrapers shaped as shown in Fig. 150 are useful in rounding angular corners. Ottolengui safe-side root-facers (Fig.

151) are also serviceable for leveling the end of a root, especially under the gum margin. As a finish, to give the cervix a smooth surface on the approximal sides and the curves to the other sides, medium coarse, then fine carborundum-paper disks and tape should be used.

Enamel cleavers, illustrated in Fig. 152, are also used to remove the enamel entire. The removal of the peripheral ring of the enamel allows the collar to be accurately adapted and fitted to take the place of the enamel and avoid creation of a shoulder. Enamel cleavers should have very short handles to afford a good grip. They should be held firmly with the finger resting on the adjoining teeth to avoid slipping. Encircling a root or crown at intervals with a wire as it is being trimmed and moving it up and down will indicate points of irregularity.

Wheels and points should be kept cool, especially when grinding teeth with vital pulps, either by application of a stream of cold water

or by frequently dipping in ice-water. A piece of sponge wet with ice-water held against the wheel with a porte-carrier, such as is used for carrying a small piece of wood in cleaning or polishing the teeth, of the form shown in Fig. 155, is admirable for the purpose and also protects the tongue and cheek from injury (Figs. 153 and 154). Coating the

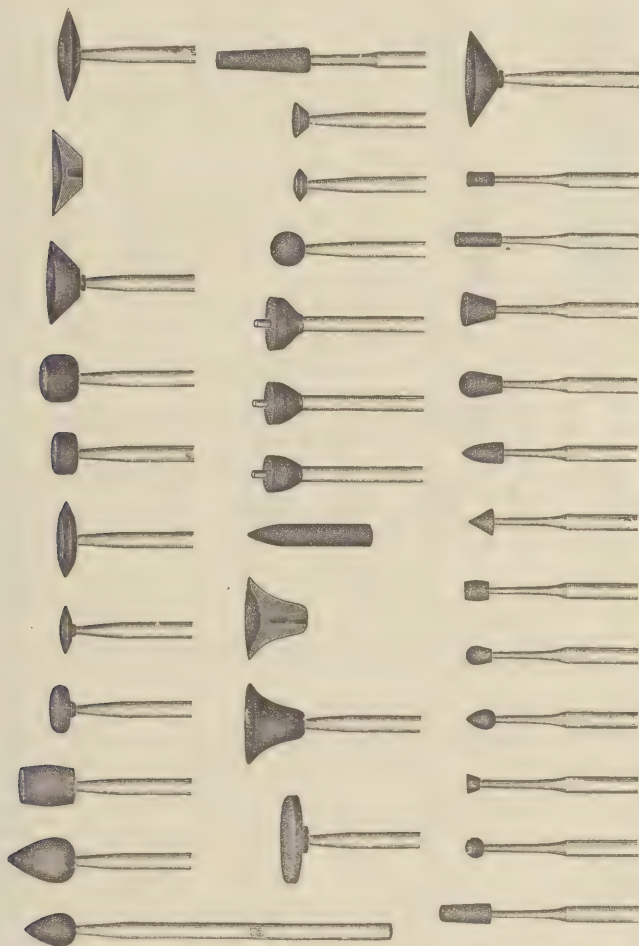


FIG. 147.

surface of a disk with wax on the side opposite to the one used will aid in protecting the membranes.

In pulpless teeth the use of excising forceps to remove the crown should be avoided unless the parts are first deeply ground with a disk (Fig. 156) and will admit of excision without shock to the root (Fig.

157). The best method of amputation is to make a succession of holes with a fissure bur. This will permit of easy removal of the part (Fig. 158).



FIG. 148.



FIG. 149.

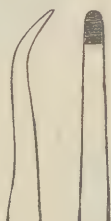


FIG. 150.

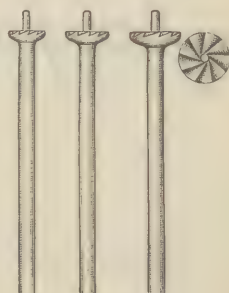


FIG. 151.



FIG. 152.

Crowns Without Collars and Ready-made Porcelain Crowns

For these crowns the roots are ground level with the margin of the gum, with the surface of the labial section trimmed a little below it, especially on the front teeth, if it is desirable to conceal the joint between the root and porcelain. The root-canal is shaped to the form of the post or dowel to fit it tightly. (See Part III, Chapter IV.)

Collar Crowns

Principles Involved.—The principles governing the shaping of the surface of a natural crown or root for any style of artificial crown with a collar attachment, require that all parts of the coronal section of the natural crown present shall be given a form that comes entirely within the line of the periphery of the cervix. Such a form is necessary to admit of a perfect adaptation of the cervical section of the collar.



FIG. 155.

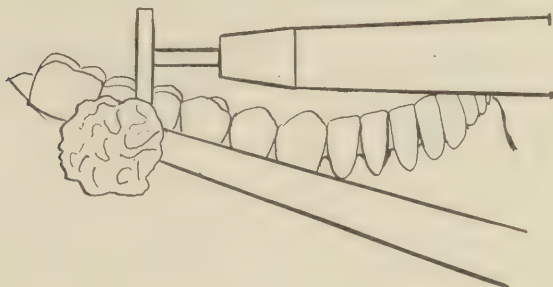


FIG. 153.

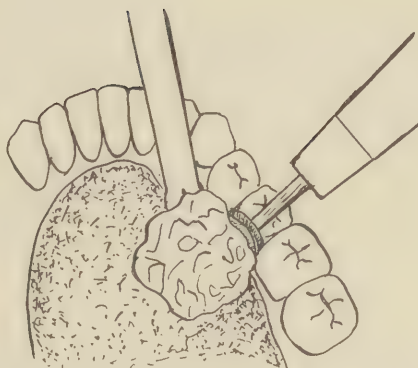


FIG. 154.

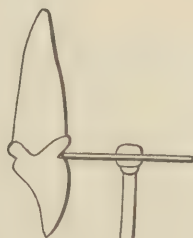


FIG. 156.



FIG. 157.

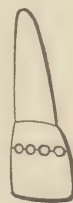


FIG. 158.

Preparation of Teeth or Roots for All-Gold Collar Crowns.—The coronal section of a natural crown to be prepared is usually first ground on the incisal or occlusal surface with as large a carborundum wheel as the case will conveniently admit and avoid injury to the

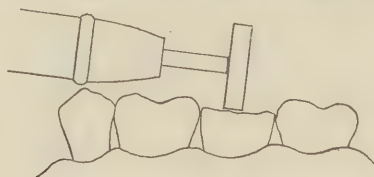


FIG. 159.

adjoining teeth (Fig. 159). Sufficient tooth structure should be removed from the occlusal surfaces to afford space for any applied intervening plate or occlusal cusps and reinforcements, which as a rule in teeth with vital pulps is one-sixteenth inch; and in pulpless bicusps

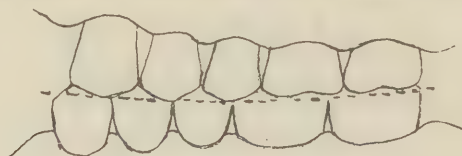


FIG. 160.

and molars is a little beyond the line of the points of the occlusal cusps of the antagonizing teeth when occluded, as indicated by the dotted line in Fig. 160. The approximal sides of the cervix should be removed sufficiently to allow a free space between the gold collar when adjusted

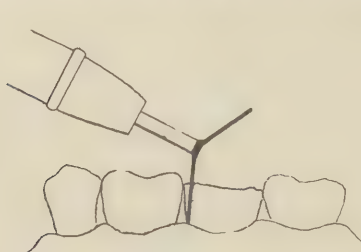


FIG. 161.

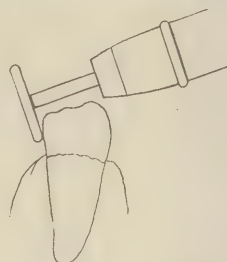


FIG. 162.

and the cervices of approximal natural teeth or artificial crowns, to make room for the gum septa (Fig. 161). Teeth with vital pulps that will not admit of proper preparation require to have the pulps removed, or some other method besides gold cap-crowning should be adopted.

In such cases, instead of pulp extirpation, some one of the inlay or partial-cap attachments should preferably be used.

The removal of the approximal sides should be first started at the occlusal surface in a straight line to the cervix, as illustrated in Fig. 161, in a case of a molar, using vulcarbo disks straight-sided or cup-shaped to get the angle (Fig. 146).



FIG. 163.

Occasionally thin safe-sided separating files are serviceable to avoid injury to the contour of an adjoining tooth in starting the trimming.

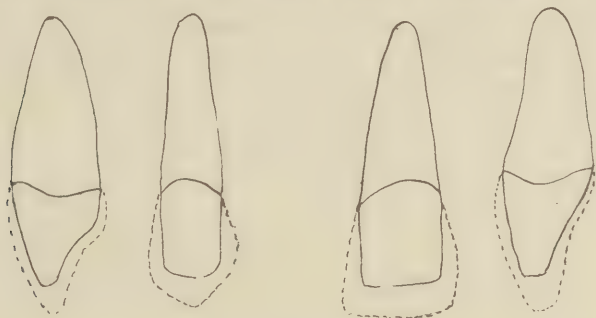


FIG. 164.

Next, as the approximal teeth are then more easily avoided, the labial and lingual portions are reduced with small carborundum wheels (Fig. 162) and vulcarbo points (Fig. 147) in the straight hand-piece and angle attachment.

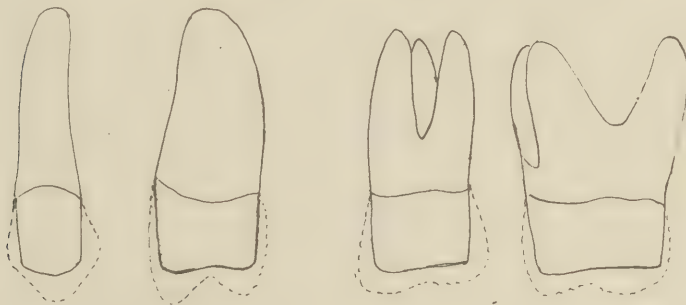


FIG. 165.

Pulpless teeth usually require complete removal of the enamel (Fig. 163). When a tooth contains a vital pulp and a portion of the enamel is allowed to remain, the surface of the enamel should be leveled

in parallel lines as far as the edge of the collar is to be extended (Figs. 164 to 166).

In preparing incisors and cuspids for gold cap-crowns where the pulp is to be retained, after trimming the approximal sides, the labial surface and incisal edge should be ground down as much as possible, without too closely approaching the pulp or subjecting it to irritation; then the lingual portion at an angle from the cervical border to the incisal edge, enough to level its prominence of contour and furnish ample space between it and the antagonizing teeth for the metal that will cover the surface (Fig. 164).

Bicuspsids and molars, with or without pulps, for all-gold cap-crowns should have as much of the natural crown left as may be without obstructing the proper and accurate adaptation and adjustment of the

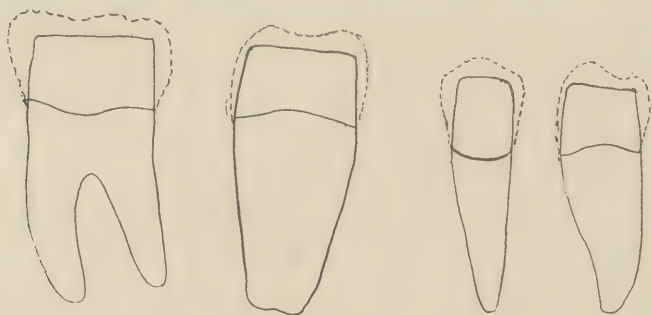


FIG. 166.

crown (Figs. 165 and 166). A slightly tapering form is advisable: a thimble shape is unnecessary and undesirable. While the approximal sides may incline toward the occlusal surface, the other sides should be more nearly parallel. This form is preferable in the constructing of the crown and is more favorable for its attachment.

The proportion of teeth with living pulps to which gold cap-crowns can be properly applied is small. The exceptions are cases in which extensive decay has involved considerable of the coronal section of the tooth and caused more or less calcification of the pulp. The preparation of these cases, of which Fig. 167, a bicuspid, and Fig. 168, a molar, are typical, consists in the trimming of the decomposed enamel at the approximal sides, a moderate reduction of the occlusal surface, and the removal of enough from the contour of the labial and lingual surfaces to allow the edge of the collar to pass over and be closely adjusted at the cervical section just under the free margin of the gum. Trimming of the tooth for the purpose of deeply embedding the edge of the collar under the gingival margin, so that it will closely approach the pericementum,

is unnecessary and not advisable unless some special condition suggests it. Irritation of the pericementum from impingement of the collar will result in recession of that membrane, also of the gingival margin and the exposure of the edge of the collar. This is the chief objection to collar crowns, as few fit perfectly around the entire cervix. Figs. 169 and 170 show a typical bicuspid and molar prepared for the adaptation of metallic cap-crowns, the natural teeth having been trimmed and the cavities sterilized and filled with amalgam or oxyphosphate covered with amalgam.

Extremely short teeth and teeth slightly embedded in the tissues, as many third molars are, when capped without removal of their pulps, do not require as much shaping as long bicuspids and first molars.

It should be borne in mind, however, that excessive or unnecessary cutting away of the enamel and dentin of teeth with living pulps, leaves them in an extremely sensitive condition, and is likely to result subsequently in some serious lesion of the pulp. Slight sensitiveness, such as may be caused by excessive shaping, is relieved by drying the



FIG. 167.



FIG. 168.



FIG. 169.



FIG. 170.

exposed dentin with hot air and applying carbolic acid two or three times as required. When this treatment is not sufficiently effective, a temporary cap of pure gold about gage No. 34 can be quickly constructed and cemented on with gutta-percha. A small quantity of a compound of oil of cloves, carbolic acid and chalk (see page 67), placed in the center of the cap acts as a sedative agent.

Collar Crowns with Porcelain Facings.—For collar crowns for the anterior teeth the end of the root is left projecting at the lingual side in removable bridge operations, and the surface of the end ground on an inclined plane towards the gum margin at the labial section, as shown in Fig. 171. For ordinary crowning operations the projecting end is usually preferably squared-off, as shown at Fig. 172. Bicuspids which are to have porcelain facings are given the same general form (Fig. 173). In preparing the roots of incisors, cuspids or bicuspids it is advisable to allow the labial section of the end of the root to project slightly beyond the gum-margin until the collar has been fitted, after which it can be reduced.

Partial Collar Crowns.—Shape the approximal and lingual sides of the root as shown in Fig. 174, leaving the labio-cervical side intact as seen at A. The surface of the end of the root is shaped as for the full collar.



FIG. 171.



FIG. 172.



FIG. 173.



FIG. 174.—A, Cervico-labial section left intact.

When necessary, the incisal edges and occlusal cusps of antagonizing teeth should be sufficiently reduced to furnish ample space for the artificial crowns, and to favor them in occlusion. Accordingly, when a tooth is to be crowned that is broken down and shortened by long-continued decay and the antagonizing teeth have consequently become elongated, they should be reduced in length as much as they properly can be to proportion the space between them and the artificial crown and improve the occlusion. When the approximal teeth are crowded against and overhang the end of a root so that the space for the artificial crown at the occlusal surface is narrower than at the cervical section measured from mesial to distal side, the approximal teeth should be pressed back to furnish space to permit the adjustment of a straight-sided collar on the prepared root and

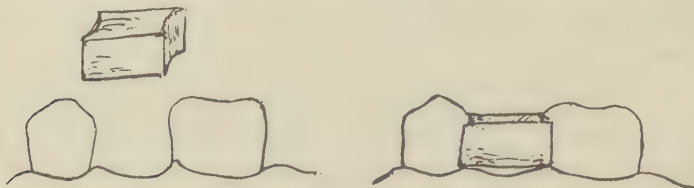


FIG. 175.

proper space between the collar and the sides of the roots of the adjoining teeth. The approximal teeth can be pressed back by packing on each side of the root with gutta-percha, or by the

insertion of a piece of orange-wood notched on the end, that tightly fits the space, the wood to be removed and increased in length at intervals by the operator or patient (Fig. 175). In cases that properly suggest it, a small portion of the interfering surfaces may be removed and polished, as shown in typical cases in Fig. 176, A and B, so as to allow parallel or slightly flaring sides to the collar.

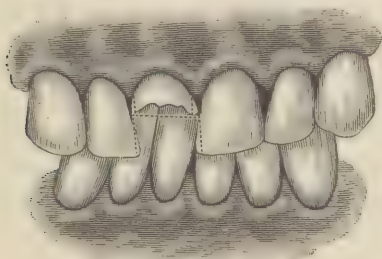


FIG. 176, A.

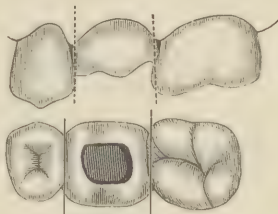


FIG. 176, B.

Special Preparation of Badly Decayed Teeth or Roots.—The temporary exposure of the end of a root or of the cervical portion of a crown for the purpose of permitting restoration of the part with an amalgam or gold inlay to simplify a crowning operation, especially in the adaptation of a collar, is effected by inserting in the pulp-chamber or the root-canal a cone-shaped piece of gutta-percha large enough to admit of a portion being brought over against the investing membranes to compress them for a day or more. In some cases to secure attachment for the gutta-percha, a wire post or a flat-headed tack may be cemented temporarily in the root with gutta-percha and the gutta-percha packed around it. Roots can thus be exposed to the border of the alveolar process, if desired, by renewals of the packing. In bicus-pids and molars, when the decay extends on the cervix further than will the edge of the artificial crown or collar, the gum margin should be compressed, as already described (Figs. 67 and 68), the decay removed, retaining pits made and the cavity filled with amalgam shaped to the contour required (Fig. 177). In such cases, when the pulp is vital, the amalgam will generally be in close proximity to it and the cavity frequently of a form unfavorable to the retention of the filling. To avoid irritation from thermal changes and to better retain the filling, a moderately thin mixture of oxyphosphate may be first placed in the cavity, the amalgam then pressed into it and the oxyphosphate forced out at the margins, where the amalgam must be brought into direct contact with the tooth structure.



FIG. 177.

In incisors and cuspids, when decay has deeply destroyed a portion of the side of the root, a tight-fitting tube of platinum veneered with a film of pure gold—to which amalgam will readily adhere—and of such size as to admit the post of a crown, may be inserted in the root-canal, cemented with oxyphosphate and the decayed portion on the side of the root restored with amalgam (Fig. 178 section). A cast gold inlay may be used with the tube instead of the amalgam. The post of the crown should be tapered at the end and inserted in the canal as deeply as possible in the sound portion of the root *beyond the end of the tube* to gain additional strength by distributing the leverage along the entire line of the root. When the amalgam has set, it should be dressed down at a subsequent sitting evenly with the surface of the root and polished.

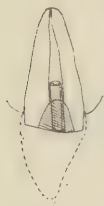


FIG. 178.

In some cases a better method is to fit and cement a pointed post as far up the canal as it can safely be introduced, leaving the end of the post protruding beyond the gingival margin. Then shape the side and end of the root with amalgam, or form a gold inlay on the post and cement to position, and cap with a gold or platinum porcelain jacket crown or one entirely of porcelain. (See pages 521 and 527.) Fig. 179 shows a typical prepared cuspid and bicuspid of this character.

When an incisor or cuspid crown post is to be inserted and the root-canal is enlarged from decay or excessive reaming, the defect in relation to the post of the crown can be remedied in the following manner: Fit a tapering post of medium size with the point reaching the extremity of the canal. Close the foramen with a very small point of gutta-percha, so that it will not interfere with the insertion of the post. Fill the canal with a thin mixture of zinc oxychlorid, insert the post and when the cement is about one-half set remove it. Instantly wipe off the post and reinsert it. The temporary removal of the post breaks the adhesion of the cement to the post so that when the cement has set, the post can be removed and you have a close-fitting socket for it. Silver chlorid cement may be used for the same purpose by veneering the post with sufficient chloro-gutta-percha to permit removal when the cement is set. This cement because of its antiseptic properties is more suitable than zinc oxyphosphate.

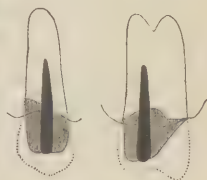


FIG. 179.

In setting a gold cap-crown on a badly broken-down tooth or root a post of either clasp-gold or iridio-platinum wire (Fig. 180) should be fitted to the root-canals (Figs. 181 to 183). The end can

be bent or a piece of gold or a globule of gold melted to it. The post should then be barbed, the point fastened in the root with a little silver chlorid cement or zinc oxychlorid and the crown built about two-thirds its length with a quick-setting amalgam, to be shaped when hard to furnish a better attachment for the cement with which the cap is set. Rolling the wire used to form the post under the flat side of a file before using will uniformly roughen the entire surface in a manner most favorable to the adhesion of the cement. Screws may be used as posts to support the amalgam, but cemented posts are preferable. A previously made and properly fitted collar of thin copper plate about gage No. 35 may be used to support the amalgam while setting.

Restoration with Gold.—The restorations described can be effected with gold casting instead of amalgam. Gold is preferable as being more

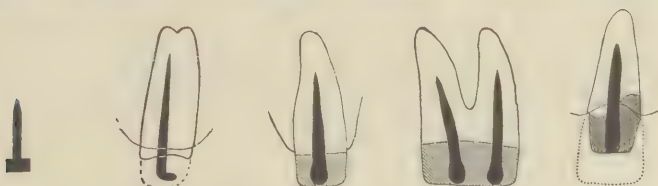


FIG. 180.

FIG. 181.

FIG. 182.

FIG. 183.

FIG. 184.

compatible to dentin, especially in cases where decay has extended so far under the gingival margin that a collar cannot be properly applied to entirely cover the part, and where an acid condition of the mouth exists. In such cases the post is first heated and veneered with sticky wax, then surrounded with inlay wax, adjusted to position in the canal and the wax pressed and shaped to the desired form. Fig. 184 shows the post of a central incisor shaped with inlay wax instead of amalgam ready for removal for casting (see page 214). The same result can be obtained by the indirect method by taking an impression with compound placed on the post, removing the post in position in the compound, and making an amalgam die on which to form the wax model.

For the use of porcelain in root restoration see Part VI.

Shaping Roots and Crowns for Cast Caps

The shaping of a root end for a cast cap on which to mount a porcelain facing or crown and for all-gold caps for bicuspid and molars, is described on page 207. The shaping of bicuspid and molars as abutments in bridge-work operations is described on pages 125, 187, and 277.

CHAPTER IV

THE ALL-PORCELAIN POST CROWNS

The all-porcelain post crowns in use at the present time are the result of progressive development of this branch of the art from what was originally styled the porcelain "pivot tooth." For this reason and because of their simplicity of construction and application they will be described first.

All-porcelain post crowns are used by many dentists almost exclusively, with the exception of the occasional insertion of an all-gold cap-crown on a posterior tooth. The reasons for this are the greater intricacy of the construction of gold crowns and personal objections to crowns with collars.

The advocates of the all-porcelain post crown claim for it natural appearance owing to translucency, the lingual aspect not being covered with metal, restoration of contour, strength and cleanliness, together with simplicity of construction and easy adaptation and attachment to the root, to which the crown is hermetically sealed.

All-Porcelain Detached-Post Crowns

In this style, which is the one now most largely used, the crown is attached to the root by a post, one end of which is cemented in the root and the other in the crown, such as the S. S. White, Dentsply, Justi and Ash.

Crowns in which the post is to be cemented admit of alignment with the other teeth more easily than those baked with the post in position. The attachment of the crown to the post, however, is not as reliable in close "bites" when cemented as when baked in the porcelain like the Logan.

The requirements for success in the use of all-porcelain detached-post crowns are:

First.—A strong, accurately fitted post, the presence of which demands the least possible removal of root structure, thereby retaining the greatest amount of strength for resistance in occlusion and mastication.

Second.—Absolute adaptation of the surface of the base of the crown to the surface of the root end or, in other words, a close joint.

Third.—Perfect alignment of the sides of the cervical section of the crown to that of the root.

Fourth.—Correct occlusion of the antagonizing teeth, by which abnormal pressure is avoided.

Preparation of the Root End.—The preparation of the canal and end of the root to receive and retain posts is about the same for all the different styles of ready-made porcelain crowns. The length of the root-canal is first measured with a root-canal probe or plugger. A small disk of rubber-dam perforated and slipped up on the shank of the instrument can be used as a gage by adjusting the disk to the end of the root. By this means the proper length for the post is ascertained. The dimensions of the root determine the size. Fill that part of the end of the canal that will not be occupied by the post; enlarge the canal with Gates-Glidden drills as deep as required to accommodate the length of the post for the crown that is to be mounted. Next, with a gage-plate determine the size of

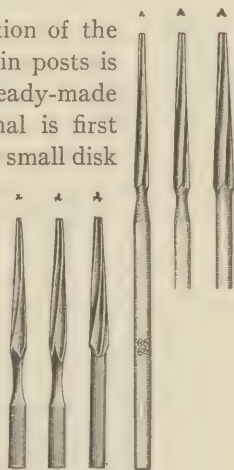


FIG. 185.

the post and with small-size fissure burs and proper size root-reamers (Fig. 185) gradually ream the canal to a form and dimension into which the post will fit closely (Fig. 186). For the anterior teeth the end of the root is trimmed to the gingival margin, slanting slightly below it at the labial side to hide the intended union of porcelain with root. This requires the removal of the enamel at the cervico-labial section but not always around the entire periphery of the root. This is best done after reduction of the end of the root with large carborundum wheels, by the use of smaller sized wheels and points or with safe-side root-facers (Fig. 187).



FIG. 186.

In these operations, as likewise in others, posts of platinum and gold or iridio-platinum are preferable to those made of alloys that contain a large percentage of the baser metals, as the ultimate corrosion of the latter tends to impair and weaken the dentin.

As the method of the preparation of the root end and adjustment and cementation of all Detached-Post Crowns is very similar, a description for one make will largely apply to the others.

The S. S. White Detached-Post Crown.—This crown possesses the main features of the Logan crown, from which it differs in having the post detachable (Fig. 188).



FIG. 187.

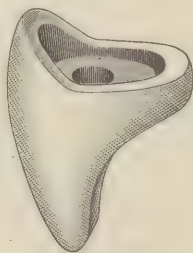
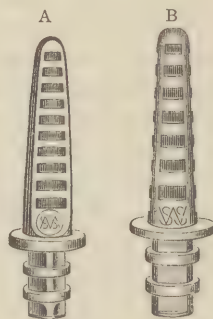
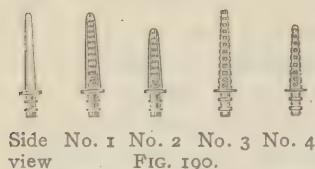


FIG. 188.

FIG. 189.—Enlarged Posts.
A, I-beam; B, round.

The base is cupped out to receive the post, with a recessed shoulder for the collar. This cup-shape form leaves only a narrow rim of porcelain at the base of the crown to be ground to fit it to the surface of the end of the root.

The post is made in two forms, I-beam shaped and round (Fig. 189). Each style is made in two sizes, large and small (Fig. 190). The

Side view No. 1 No. 2 No. 3 No. 4
FIG. 190.

I-beam post is similar in form to the post of the Logan crown. Both it and the round post taper toward the point. The root section of each style is grooved and the portion that enters the crown has small flanges with a large one that rests

on the shoulder of the cup and being close to or against the root end prevents movements of either the post or crown.

Preparation of the Root.—The root is prepared the same for either the direct or indirect method. The canal is opened up with a twist drill to the proper depth, and large enough to permit the easy entrance of an Ottolengui reamer (Fig. 186). Shape the canal with the reamer to conform generally to the root section of an S. S. White detached post, tapering toward the apex, with the labio-lingual diameter greater than the mesio-distal for an I-beam post. Then with a root-facer give the end of the root labio-lingually a rounded open V shape (Fig. 187).

Direct Method of Fitting the Crown.—To fit the crown to the prepared root grind freely as indicated, an operation that is greatly

facilitated because the cup shape of the cervical portion leaves only a comparatively thin wall of porcelain to cut away. At this stage of the fitting the use of a disk of articulating paper will simplify and

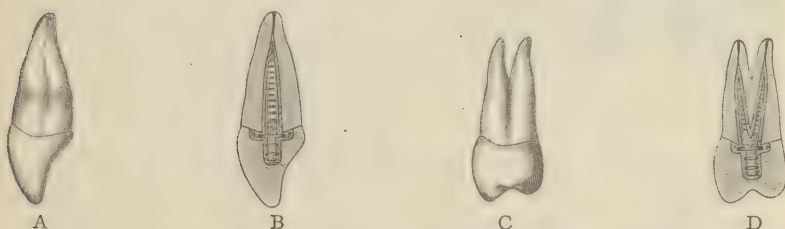


FIG. 191.—Actual size. A, Detached-post crown, cuspid, fitted to root; B, the same, sectional view; C, Detached-post crown, bicuspid, fitted to root; D, the same, sectional view, showing the splitting of the post for a bifurcated root.

facilitate the operation by marking on root and crown the point of contact.

Another method: Dry the end of the root, rub a carbon pencil point over it and press the porcelain against it. After fitting the crown, adjust the post to root and crown. The shoulder in the recess is intended as a bearing for the circular flange of the post to distribute the stress.

In cementing the crown in position, the post can be fixed into the root first or into crown and root together, according to the preference of the operator.

The requirements for a lasting operation are a perfect fit and a reliable cement (Fig. 191). Fig. 192 shows well-fitted and articulated crowns.

Indirect Method.—After shaping the root as in the direct method and fitting the post, warm the root section of the post and veneer it with wax, flowing it into the grooves, and adjust the post in the canal. Next take a “bite” in wax and then an impression in compound, which will remove the post in position. Pack amalgam—True Dentalloy—into that portion of the compound impression which represents the end of the root and sides of the approximal teeth, in quantity sufficient to entirely cover the form of the crown end of the post, then fill in the remainder of the impression with plaster. The model must be allowed to remain long enough for the amalgam to set before separation. The result will be a combined plaster and amalgam (metallic) model, an

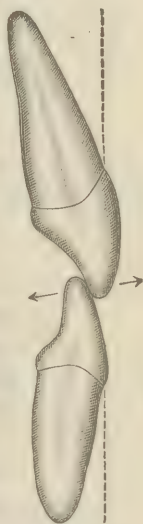


FIG. 192.

exact replica of the root and of the approximal teeth with the post in position (Fig. 193). An articulating model is then made. With these

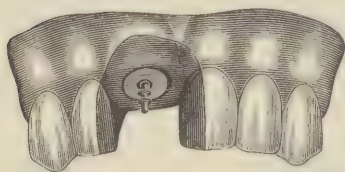


FIG. 193.

models the proper crown can be selected and the fitting done accurately. The wax on the surface of the post will allow it to be removed easily. In fitting the crown to the model by slight pressure and

lateral movement, the places to trim will be distinctly marked on the porcelain by the amalgam. The countersink in the crown is of sufficient diameter to permit the post to be set at various angles, and

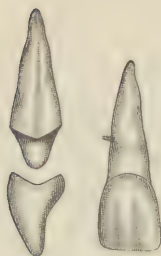


FIG. 194.

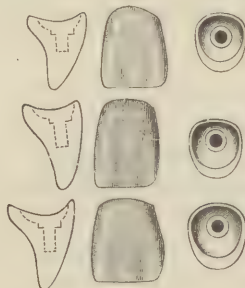


FIG. 195.



FIG. 196.

provides room for any necessary body of cement besides the porcelain, which is roughened to insure it a firm attachment.

In the use of detached-post crowns, when necessary for some special purpose, the hole in the porcelain may be enlarged or its angle changed slightly with carborundum points or steel points charged with carborundum paste. In this manner the S. S. White Detached-Post Crown can be readily adapted as a jacket crown (Fig. 194). (See Part VI, Chapter VIII.)



FIG. 197. FIG. 198. FIG. 199.

The Dentsply Crown.—This crown is illustrated in Fig. 195. It is made in three forms typical of square, tapering and oval teeth. In application its adjustment and cementation are similar to those of other detached-post crowns.

The Justi Shoulder-Pin Crown.—This crown, illustrated in Fig. 196, is also very similar in construction to the other makes. The method of its application is similar.

Ash's Tube Teeth and Crowns.—These teeth have a perforation through the center with a thin platinum tube baked in the porcelain. They are supported on the root by a fluted post. Figs. 197 to 199 show teeth and post. When the crown is properly ground and fitted, the base is to be countersunk sufficiently to receive the shoulder of the pin. The pin is then bent so as to allow the crown to assume its proper position on the root. The socket-handle instrument, shown in Fig. 200 is the most suitable for this purpose. The attachment of the crown is made by first securing the pin in the crown with sulphur

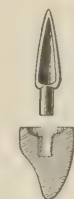


FIG. 201.



FIG. 202.



FIG. 203.



FIG. 204.



FIG. 205.

or soft solder and then cementing the fluted post in the root-canal with oxyphosphate.

Figs. 201 to 204 illustrate Ash's dowel crowns. They are applied in a manner similar to the other detached-post crowns. The dowels or posts are made of what is termed "Dental Alloy" and are the strongest at the part that bears the greatest strain—the portion where the crown joins the root.

Examination of the Periphery of a Porcelain Post Crown.—

FIG. 200. When a crown of this class has been fitted, before cementation an examination should be made to ascertain whether, as is a common occurrence, the base of the cervical section extends beyond the line of the side of the root, forming a shoulder, as seen in Fig. 205. Its removal is frequently neglected in the insertion of these crowns. This shoulder forms a ledge which, if allowed to remain, causes and maintains a septic condition that impairs the health of the investing membranes and is liable to cause decay of the end of the root.

Removal of Excess of Porcelain at the Periphery.—This is easily and accurately done, as follows: Warm a disk of pink base-plate gutta-percha with a large hole in the center to accommodate the post (A, Fig. 206). Wipe the surface with a pellet of cotton moistened with chloroform or oil of cajuput; warm the gutta-percha and press it against the base of the crown. Gradually heat crown and gutta-percha until too hot to be comfortably held in the fingers and press to position on the root, chill and remove. On the gutta-percha will be found an accurate impression (B) of the end of the root. The surplus gutta-percha is removed to the surface of the porcelain with a sharp knife (C), and then the porcelain to the line of the root, as indicated by the impression in the gutta-percha, with a carborundum wheel lightly pressed and rapidly revolved in a direction which will not disturb the gutta-percha (D). During the grinding the crown should be frequently dipped in ice-water. One or more adjustments of the crown and gutta-percha should be made on the root and the sides carefully examined with a suitable instrument. After removal of the projecting edge of porcelain, the remainder of the crown should be trimmed to harmonize

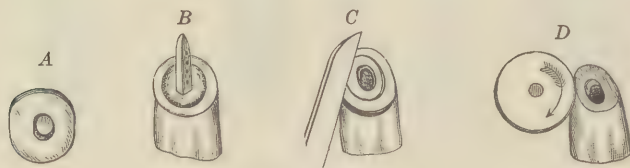


FIG. 206.

in contour with the neck, and the surface polished with fine sandpaper disks and oxid of tin (putty).

Cementation.—These crowns are generally cemented entirely with zinc oxyphosphate. To cement a detached-post crown the root is protected and dried with hot air. The cement is mixed to a medium consistence, worked into the root-canals and the countersunk base of the crown. A portion is then applied to the surface of root and crown, and the crown pressed to position and held until the cement has at least partly set. The surplus should not be removed until it has thoroughly set, as the cement will then snap off, not drag from the joint.

In cementing all-porcelain detached-post crowns the preferable method is to first cement the post and then instantly place the crown without cement in position over the post to define its alignment positively. When the cement has set then cement the crown to the post.

Some conditions may suggest the reverse, *i.e.*, the cementation of the post in the crown first.

Another method is to apply a disk of gutta-percha to the base of the porcelain or leave the disk on the crown that was used to outline the periphery of the root and then cement the post in the root and crown with oxyphosphate. The object is to have a cement at the joint that will not wash out. The pink base-plate gutta-percha is the most durable for the purpose.

Remarks on the Use of Porcelain Ready-made Crowns and Crowns without Collars.—All-porcelain post-crowns have some decided advantages. When properly fitted to a root end, the line of union of porcelain and dentin is more benign to the gingiva than the presence of a metallic collar. They are especially useful in many case where an inexpensive or easily adjusted crown is required, or where some pathological condition limits the probable durability or permanence of any operation. In the insertion of porcelain crowns the removal of the whole or a part of the natural crown, which could be utilized to some extent as a foundation by another system, has given rise to various objections. If the natural crown is entirely cut away the pin, or post, upon which almost the entire support of the artificial crown is thrown, exerts great leverage in the root-canal when no band or brace is present on the exterior of the root to relieve the strain. With the entire force of mastication bearing directly upon these pulpless roots, whose disintegration is slowly but continuously progressing, they are liable to be fractured and their usefulness as a foundation ended. These facts and the lack of strength incident to conditions such as close or abnormal occlusions are the principal objections urged against porcelain crowns on uncapped roots as ordinarily inserted.

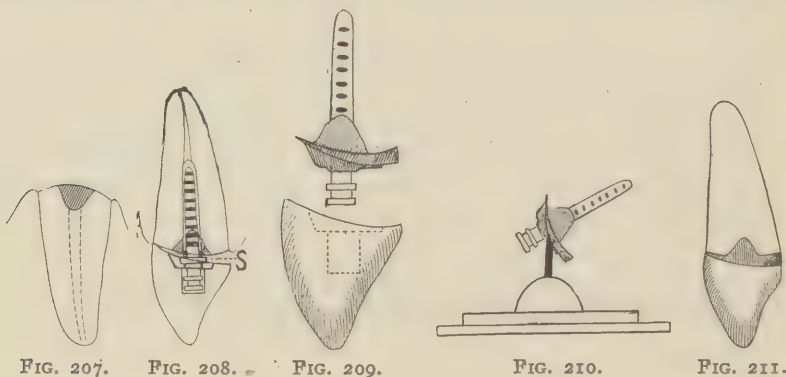
CHAPTER V

PORCELAIN-POST CROWNS WITH METALLIC BASE

A TEMPORARY CROWN

Porcelain Detached-Post Crown with Cast Base.—Sometimes the end of the root is decayed under the gum margin so unevenly that the base of the porcelain crown cannot very well be ground to properly fit it (Fig. 207). In such a case a cast floor or cap should first be made and applied, upon which the porcelain crown can rest and to which it can be attached.

Direct Method.—Grind the exposed portion of the end of the root well under the gum-margin and remove all decay. Pack and repack



gutta-percha in the canal and over the end of the root against the tissue for a few days to properly expose the parts. Fit an iridio-platinum post, or one that is made for the crown that is to be inserted of the same metal, well up into the canal. Grind a porcelain detached-post crown to fit the cervico-labial section of the root, leaving a V-shape space between the crown end and the root at the lingual side (S, Fig. 208). Vaseline the base of the crown and wipe off all surplus; heat the exposed end of the post and veneer it with sticky wax. Next surround the end of the warm post with inlay wax; insert post in root; dip crown in warm water and press to position. Trim and shape the wax on the sides and chill with a stream of cold water. Remove the crown from

the mouth, then the post with the wax attached without disturbing its form (Fig. 209). Insert sprue wire in the thickest part of the wax (Fig. 210) and cast with pure or 22-carat gold. Fit casting to root and crown to casting, polish and cement. Fig. 211 shows the finished crown.

Indirect Method.—Fit an iridio-platinum post in the root the same as for the direct method, Heat the post, veneer it with compound, wet the canal, insert and withdraw the post as the compound hardens so that the post may be easily inserted and withdrawn. Take a “bite” in wax and an impression in compound that will remove the post in position. Vaseline the end of the post, pack in amalgam around the impression of root and post, and run the remainder of the impression with plaster. Adjust “bite” to model and run articulation. Should the cavity on the side of the root extend very far under the gingiva, instead of the method just described take an impression of the root and post in a tube and make an amalgam die with a cone-shaped shank. Take an impression of the case and fit the die in the impression and make models. The models will give the exact form of the root and the position of the post as in the mouth. Remove the post from the die by seizing the exposed end with heated pliers, holding them for a moment on the post to warm it. Remove any compound on the post and replace the post again in the model. The construction of the crown on this model is identical with that described in the direct method.

Porcelain-Faced Gold Post Crown

This form of construction is generally confined to the six anterior teeth. The root of a cuspid will be taken as a typical case to illustrate the construction.

The end of the root is prepared the same as for an all-porcelain crown, as shown in Fig. 212. No peripheral trimming is necessary. To have the joint of the porcelain entirely invisible in the finished crown, the surface of the end of the root should be trimmed off enough to allow for the thickness of the metal plate that will cover it, especially at the labial side, and thus admit placing the edge of the porcelain facing well under the cervico-gingival margin.

As crowns of this style are principally supported by the post, it consequently constitutes an important factor. Iridio-platinum or gold-platinum wire, about gage No. 13, is commonly used, but the requirements of some cases call for it much lighter or heavier.

The root-canal is enlarged with a reamer and the orifice well counter-sunk. A piece of iridio-platinum or gold-platinum wire, that has been

rolled under a file and tapered off to a point, is fitted well up the canal, gaged its full reamed diameter, so that greater strength shall be obtained and the root rendered less liable to longitudinal fracture from pressure in a forward direction (Fig. 213). A post of the exact size and shape of the canal, made as described at page 184, of platinum wire, foil and gold, is a good form to use in a large canal with this style of crown.

A piece of platinum plate in size slightly larger than the end of the root, of gage No. 34 to 36—the smaller the root the thinner the plate—is adapted to it by pressure with a ball of cotton or the soft rubber tip of a pencil; or an impression may be taken of the end of the root with impression compound, an amalgam die made and the platinum plate or cap first stamped in a swager. (See page 193.) The platinum plate is then burnished to the surface of the end of the root and well into the countersunk orifice of the pulp-canal and punctured with a sharp-pointed instrument. The point of the post is next pushed



FIG. 212.



FIG. 213.



FIG. 214.

through the perforation to position in the canal. When the post is withdrawn from the root, the platinum generally adheres to it. A particle of pure gold with flux is put in the joint in a Bunsen gas flame. The least quantity of gold that will unite the parts should be used. If the post does not fit sufficiently tight to remove the platinum plate, it should be connected fast with wax, removed and invested. When soldered, the post and plate are again adjusted in the mouth and the plate malleted and burnished to the end of the root so that the edge of the root shall leave its imprint on the platinum plate. The plate on being removed should be trimmed to this mark and again burnished on the root. The post is then cut off and trimmed and a porcelain facing fitted, backed, the incisal edge protected, and the facing cemented with wax in position on the cap, as described on pages 179 and 180. The whole is then removed, invested and soldered with 20-carat solder, which should be melted in at the base of the post, as the strain is very great at this point, when the crown is in use. See page 176.

The crown is cemented to the root with oxyphosphate or silver chlorid cement (Fig. 214).

Root End below Gum-Margin.—The crown just described is a suitable form for application in cases where the cervical section of the end of the root because of either decay or fracture is considerably below the surface of the gum and does not admit of the use of a collar. In such cases the end of the root should be first fully exposed with gutta-percha fastened in the orifice of the root-canal and extending over the surface of the end of the root, pressing away the gingiva. Under such a condition shaping the plate or cap to the form of the root by the use of a die facilitates its adjustment.

TEMPORARY CROWNS

Porcelain-Faced Temporary Crown.—Fit into the root-canal a tapered post made preferably of German silver wire. Let the post extend out of the canal about one-eighth of an inch, and roughen its sides. Perforate a disk of the heaviest pattern tin, pure gold gage No. 28, or $\frac{1}{1000}$ platinum foil, with the post and fit to the end of the root. Fit a suitable two-pin vulcanite porcelain tooth to the disk; groove out



FIG. 215.

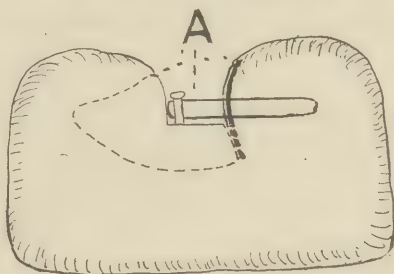


FIG. 216.

the porcelain, if necessary, to fit over the post (Fig. 215). Wax the porcelain tooth to the disk and post, remove and invest in plain plaster of Paris. Remove the wax with boiling water and apply a little muriate of tin to the end of the post. In the place occupied by the wax (A, Fig. 216) flow fusible metal which melts at not less than 200°F., and instantly, while the metal is yet in a molten state, press it down firmly into the investment with the finger covered with a napkin, cool, remove, trim and cement on the root with gutta-percha that softens at a low heat.

Silicate Cement Temporary Jacket-Crown

In jacket-crown construction for a tooth with a vital pulp, when the coronal section has been prepared, a temporary crown can be quickly

made to apply until the permanent crown is completed. The temporary crown is formed as follows. Select and fit over the prepared tooth a suitable celluloid tooth-form. Cover the prepared surface of the tooth with a layer of thin tin foil. Puncture the incisal edge of the tooth-form to let out air and fill it with the proper shade of the cement and press to position over the foil.

When the cement has set, remove and do any necessary trimming to the cement and foil and cement on the temporary crown with gutta-percha temporary stopping or cement, so that it can be easily removed by heating when the permanent crown is finished.

In the construction of a post or collar crown, cement a post in the root-canal with gutta-percha with the end extended beyond the root-end $\frac{3}{16}$ of an inch more or less as the conditions suggest. Cover the exposed end of the post with tin foil and construct and apply the temporary crown as in the preceding case.

CHAPTER VI

GOLD COLLAR CROWNS

This style of gold crown includes those methods which involve banding, capping and hermetically inclosing with gold the end of a root for the purpose of securing stability to the artificial crown, and preventing fracture of the root; also the capping of crowns of natural teeth. These methods possess much practical value as a preserver of tooth structure, as a restorer of usefulness to the teeth, and as affording support for bridge-work.

Collar crowns of which the part that essentially constitutes the cap is constructed in sections, will be first described.

The Construction and Adaptation of Collars.—This may be termed the fundamental part, as on its skilful and proper performance depends the usefulness of collar crown operations.

Careful study of the different forms of natural crowns and roots and of the anatomical structure and relationship of the contiguous parts is most essential for the perfection of construction and adaptation required in collars, bands or ferrules, as they are variously designated.

Some devices and methods in use facilitate this operation, but its skilful performance can be attained only by study and practice, as is proved by the easy and perfect manner in which it is done by experts in crown- and bridge-work who use no special appliances and are guided by an intuitive perception of the requirements of each case.

Gold alloys of at least 22 carats containing 2 to 3 per cent. platinum, gage No. 30, are preferable for collars, as the joint can be soldered with pure or coin gold, which permits the use of a high-grade solder in the construction of the work. U. S. gold coin is not so much used as formerly, as the 10 per cent. copper it contains tends to cause oxidation and as it is not high fusing it requires more care and skill in its use in soldering operations than plate of the higher fusing alloys.

The size of the cervix of the root or dimensions of the natural crown to be capped, whether it is to effect only restoration of the crown or to give support to bridge-work, should govern the choice of gage of plate

to be used. Cuspids and molars require a heavier plate than small laterals or lower incisors, and in all forms of gold caps the gage should be slightly increased when they are to support bridge-work.

To Measure the Circumference of a Root or Tooth.—The natural crown or root having been properly prepared is measured. For the circumference form a loop of copper or iron wire, gage No. 30 or 31, by twisting the ends together with the pliers. Slip the loop over the



FIG. 217.

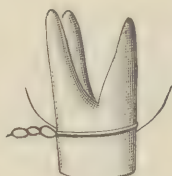


FIG. 218.



FIG. 219.

tooth or root, press the wire down under the gum margin and twist the ends with the pliers until the loop fits tightly at every point (Figs. 217 and 218). Slip off the loop, extend the wire and cut the center opposite the twist, then extend the ends lengthwise, as shown in Fig. 219.

The Dentimeter.—A dentimeter, such as is exhibited in Fig. 220, facilitates measurements with wire. The ends of the wire are passed into the hole in the point of the head and out through the openings

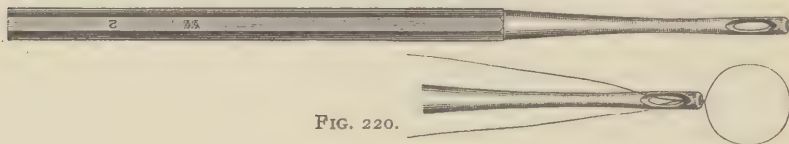


FIG. 220.

which are cut into it from the two sides. The loop thus formed is adjusted in a straight line around the tooth or root, the end of the dentimeter is pressed against the root at the gingival margin and the ends of the wire fastened to the boss on the handle. A few turns of the dentimeter will twist the loop tight. The ends of the wire are next detached from the boss, the dentimeter laid aside and the loop removed. Teeth and roots difficult to reach at the buccal side may often be more easily reached at the lingual.

To Determine the Width of a Collar.—For an all-gold crown measure from the occlusal surface of the antagonizing teeth to the point at

the cervical section showing the greatest recession or curve in the gum-margin in an apical direction. For a collar for a root-cap determine by the eye, or in a similar manner measure apically from the surface of the most projected portion of the end of the root to the cervix. This measurement is best done, as shown in the case of a molar in Fig. 221, with a tapering strip of copper or cardboard with the ends squared. Cut off the narrow end until it gages the space. The measurement may also be taken with a pair of dividers.



FIG. 221.

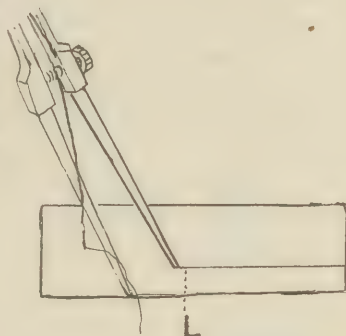


FIG. 222.

Cutting the Plate for the Collar.—Place the extended wire loop on the surface of the plate of which the collar is to be constructed in the line of the laminae of metal, *i.e.*, the direction it has been rolled, and mark the length. Next mark the width by the measure taken, adding one-sixteenth to one-eighth of an inch additional for the free space under the gum-margin and any accidental discrepancy. Gage a pair of dividers to the mark and draw a line on the plate, as shown in Fig.

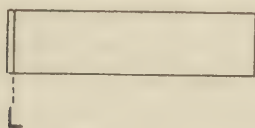


FIG. 223.

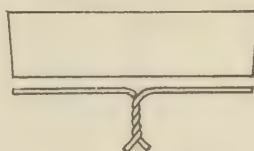


FIG. 224.

222. Cut the plate along this line to the mark indicating the length (L, Fig. 223) and about one-thirty-second to one-sixteenth of an inch beyond it to allow an excess for an overlap.

When the collar is to restore a very large amount of contour to a bicuspid or molar, the collar may be cut across on a slight bevel, flaring from the cervical to the occlusal edge, as shown in Fig. 224. The objection to a collar cut in this form is that as the cervical edge is trimmed, the circumference is increased in size, a matter difficult to calculate on by measurement in most cases.

Taper the edge of the plate for the under-lap from the mark indicating the length to the edge of the excess, as viewed laterally enlarged at L, Fig. 225. Next slightly taper the other end of the plate for the outer-lap, as shown at OL; bend the plate in a circle, and lap the ends and bring them in contact with suitable pliers (Fig. 226) in the manner shown enlarged in Fig. 227. Seize the collar at the joint with a clamp and hold it in a Bunsen flame until it assumes a dull red, then instantly dip in water. This will cause the metal to retain the curve given it by setting the molecules and will permit the tapering edges of the collar to be brought together more easily. Repeat the



FIG. 225.

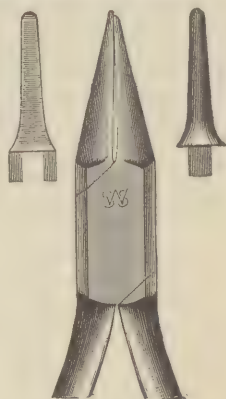


FIG. 226.

clamping, annealing and chilling of the collar until as perfect a contact of the ends as is possible is effected.

To Solder the Joint of the Collar.—Flux the joint; grasp the over-lap end of the collar, as shown in Fig. 228, and place a minute piece of solder on the surface of the inner lap close to the joint and hold the collar in a Bunsen flame until the solder fuses. The presence of the clamp takes enough heat from the overlap side to cause the solder to flow only

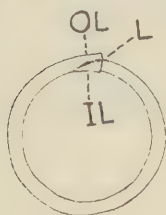


FIG. 227.

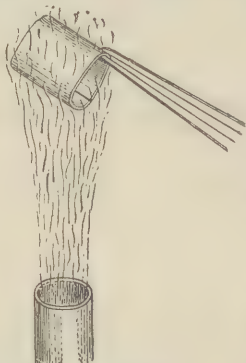


FIG. 228.



FIG. 229.



FIG. 230.

on the inner lap side and into the joint. The position of the clamp is then changed (Fig. 229), and the solder flowed across the joint. In this way the particle of solder applied is prevented from flowing on the over-lap instead of into the joint. The smallest possible quantity of solder only is to be applied, and it should be as hard-fusing as the grade of the gold of the collar respecting fusibility will permit.

Another method is to grasp the seam at the cervical side of the collar with the points of a clamp or soldering pliers (Fig. 230) of the styles illustrated in Figs. 231 and 232 and unite the seam only at the extreme outer edge with an atom of solder fused with a blowpipe. The points of the clamp or soldering pliers prevent the solder from flowing along the joint. The cervical side of the collar is left open by this method, which permits the collar to be slightly contracted when fitted, if desired; after which the solder is flowed across the entire joint.

The collar when soldered is slipped over the point of a small anvil and the joint lightly tapped (Fig. 233).

Sweating Method.—To unite the joint by the sweating method, see Union by Sweating, page 41.

Fitting a Collar to Root or Tooth.—When the collar seam has been soldered, it is shaped to the general form (Fig. 234) of the root or tooth for which it is intended, as illustrated in Fig. 235. The collar is then placed on the root or tooth and pressed or, with the aid of a piece of wood placed across its outer edges, gently tapped up to the margin of the gum. A line parallel with the margin is marked with a sharp-pointed instrument on the collar (A, Figs. 236 and 237), which is then removed, trimmed to this mark, re-adjusted and again marked (B), and the process continued until the collar fits correctly under the gingival margin, using straight or curved small pointed shears for the cutting (Fig. 238).

To definitely determine the distance the edge of a collar fits under the gum margin, especially at the interproximal space, heat the collar, veneer its outer surface with wax, then place a small roll of soft wax around the edge. Slightly warm the wax and press the collar to position and remove. The edge of the gum will

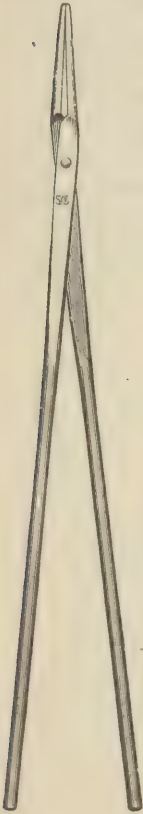


FIG. 231.

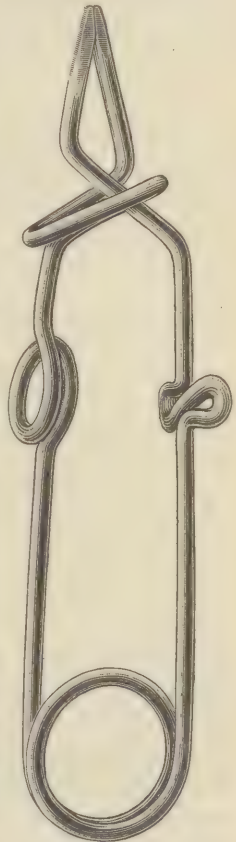


FIG. 232.

press back the wax and on examination of the collar the wax will exactly indicate how far the collar extends under the gum (Fig. 239).

If the operation of collar adjustment is skilfully performed and the collar is not forced into the investing membrane of the root, very little pain will be caused the patient.

If, on adjusting, a collar is found a trifle too small, it can be slightly enlarged by tapping with a riveting hammer on an anvil the excess of gold usually present at the joint (Fig. 233). By this means any surplus gold at this point is thrown into the collar and its circumference proportionately enlarged without materially altering its gage. If, on the contrary, the collar should prove to be too large in circumference, the

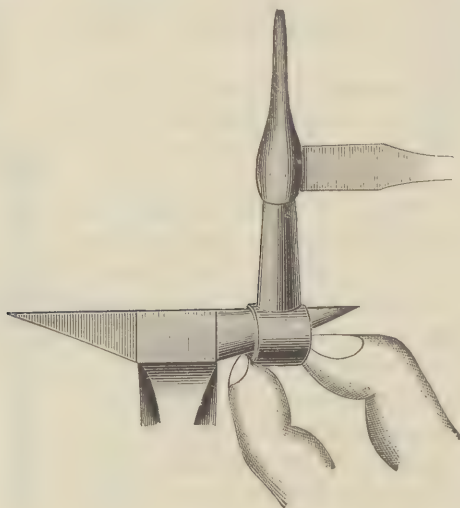


FIG. 233.

difficulty can only be remedied by cutting the gold across the side opposite the joint, beveling and lapping the edges slightly, soldering and trimming, or by making a new collar.

The collar having been fitted, the edge is burnished to the periphery of the root. For this purpose burnishers shaped to suit the different positions and avoid irritation of the margin of the gum should be used (Fig. 240). Finely serrated foot-shape gold foil condensers can be advantageously used to flatten an edge of a stiff or angular point of a collar.

Platinum Collar.—Platinum or iridio-platinum is the ideal metal for collars and is gradually being more used. It withstands the action of the secretions of the mouth better than gold and its presence is

consequently more benign to the tissues, in which respect it ranks next to porcelain. Being malleable and infusible, it can be easily and accurately adapted.

Platinum plate, gages Nos. 31 to 32, is used in the same manner as gold, the soldering of the joint and floors being done with pure gold, or with platinum solder when it is to be used for porcelain crown-work.

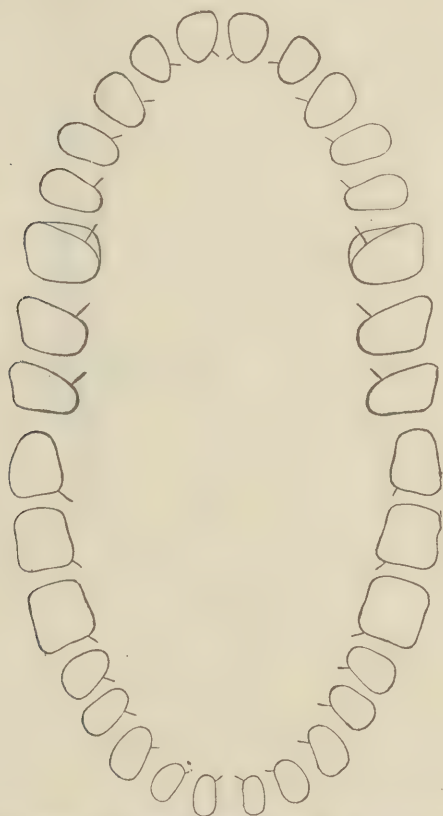


FIG. 234.—The palatal side of the superior molars, in many cases, is of the large oval form indicated by the outer line to the form of the first molar. The small spurs indicate the points generally found the most suitable to make the joint.

In fitting a platinum collar, the cervical portion may at the same time be trimmed to a fine edge to facilitate the adjustment under the gum-margin, as there is no danger of fusing the edge in subsequent soldering.

Reinforced Thin Platinum Collar.—This style of collar is advantageous to use in capping roots complex in form and difficult to fit, or in cases where the collar has to extend far under the gum-margin. The



FIG. 235.



FIG. 236.

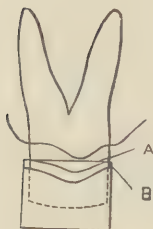


FIG. 237.



FIG. 238.



FIG. 239.

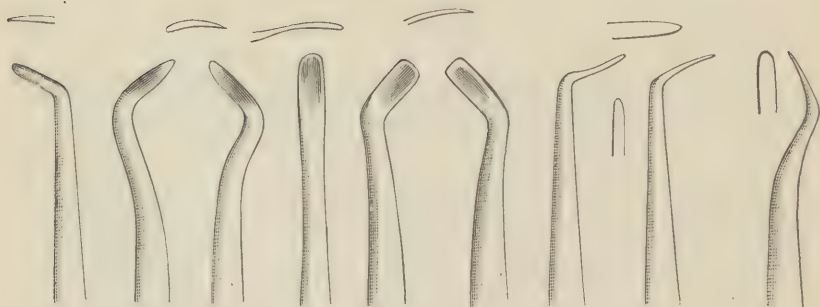


FIG. 240.

collar is made of pure thin platinum plate about gage No. 38. At this gage platinum can be easily fitted and accurately adapted. The reinforcement of the fitted collar is most conveniently done by flowing pure gold over the outer surface. The inner surface of the collar is painted with a thick coat of rouge. The gold is cut in small pieces and successively applied and fused around the entire circumference of the collar. If there are any uneven places in the surface of the applied gold, they can be trimmed level when the floor has been attached to the collar.

Another method is to fit the thin platinum collar to the root, attach the floor and then reinforce the collar by the casting process. The difficulty encountered by this method is that the contraction of the gold is liable to interfere with the re-adjustment of the collar or cap on the root.

Platinum-lined Gold-Plate Collar.—When this form of plate is used, owing to the uneven expansion and contraction of the two metals, the joint requires to be securely clamped while being soldered.

For Cast Gold Root-Caps and Crowns, see page 207.

Application of a Local Anesthetic.—The application of a local anesthetic to the gingivæ is suggested in fitting collars. Adrenalin and cocaine are much used, applied as described on page 119. Some of the excess of the application which will usually be found at the cervix may be rubbed on the labial and lingual sides of the gum. A little of the solution may be placed on the inner edge of the collar before it is adjusted on the tooth or root. The patient should be directed not to swallow the saliva during, and for some time after, the application of the cocaine. The anesthetic effect produced by this method is of such duration that it will usually be found sufficient to partly or entirely divest the operation of pain and will seldom require repetition except in lengthy operations.

Collar Crowns Hygienically Considered.—The principal argument against collar crowns is that they are productive of irritation to the periodontal membrane, ultimately causing its absorption and exposure of the collar. This would be theoretically and practically true of a rough or porous substance encircling the root or of an imperfectly and unskilfully fitted or adjusted or cemented collar, which would by its presence hold a position analogous to a calcareous deposit; but it is not fairly predicated concerning a perfectly fitted collar forming at its edge a smooth union with the sides of the root and presenting a uniform and benign surface to the investing membrane. The fact should, however, be borne in mind, that a collar of any form is not applied for hygienic purposes, but as a necessity, and at times as an unavoidable adjunct of some restorative operation.

In the case of perfectly adapted collars, when an irritation of the membrane exists, it will usually be found to result from such causes as produce it when the natural crowns are presented, namely, dental concretions. A tarnished and unclean condition of the surface of the gold of the collar will produce irritation of the membranes, which is a matter independent of the collar itself and easily remedied by cleaning and polishing the surface. Where an acid condition of the secretions of the mouth exists, a collar of platinum is suggested in preference to gold, as this metal will not be affected, but will constantly present an untarnished surface. Infection of the cement under a collar will cause inflammation of the gingival margin independent of the collar. This suggests the use of an antiseptic cement.

When evidence of a tendency to pyorrhea alveolaris exists, a collar adjusted to support bridge-work should not be extended under the gingiva, but a space should be left between the edge and the gingiva so as to better permit treatment of the disease. When this is not practical the collar should be made of platinum plate with the edge well tapered and closely fitted and burnished.

CHAPTER VII

ALL-GOLD COLLAR CROWNS FOR BICUSPIDS AND MOLARS CONSTRUCTED IN SECTIONS

The root and crown having been properly prepared, the collar is formed and adjusted as described in Chapter VI, and the edge towards the antagonizing teeth trimmed to the line of the points of the cusps to fully clear them in occlusion and provide space for the placing of a properly contoured cusp-cap. The collar is then slightly expanded toward the occlusal surface for better contour and the edge trimmed perfectly square and level by rubbing on the flat surface of a very fine file.

Methods of Knuckling the Collar and Giving Contour.—If the collar is long enough a contour approximating that of a natural tooth can be imparted to the side with the aid of suitable pliers, such as are illustrated in Fig. 241, the Robinson, one beak of which is rounded at the point and shorter than the other. The Peeso contouring and stretching pliers, Fig. 242, and the pliers, Fig. 243 are useful in shaping and removing inequalities caused by the use of the first form. A close knuckling can be insured by pressing the collar against the approximal teeth in the manner shown in Fig. 244.

Methods of Forming the Cusp-cap.—For the formation of cusp-caps there are a number of methods, of which only those most practical and most used will be presented. They will be placed in three classes: A, Stamping or swaging on the surface of dies; B, Shaping in intaglio or counter dies; and C, Casting.

In class A the outer surface of the cusp-cap is larger than the die the thickness of the gage of gold plate used, and the inner surface the exact size of the die.

In Class B the outer surface of the cusp-cap is the size of the intaglio or depressed die, and its inner surface is smaller by the thickness of the gold.

In class C the casting is an exact replica of the wax model of the required cusp-cap.

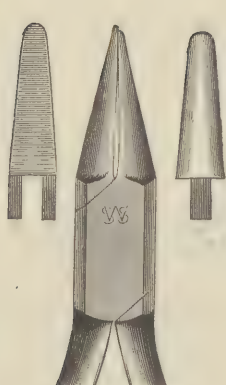


FIG. 241.



FIG. 243.

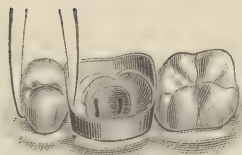


FIG. 244.

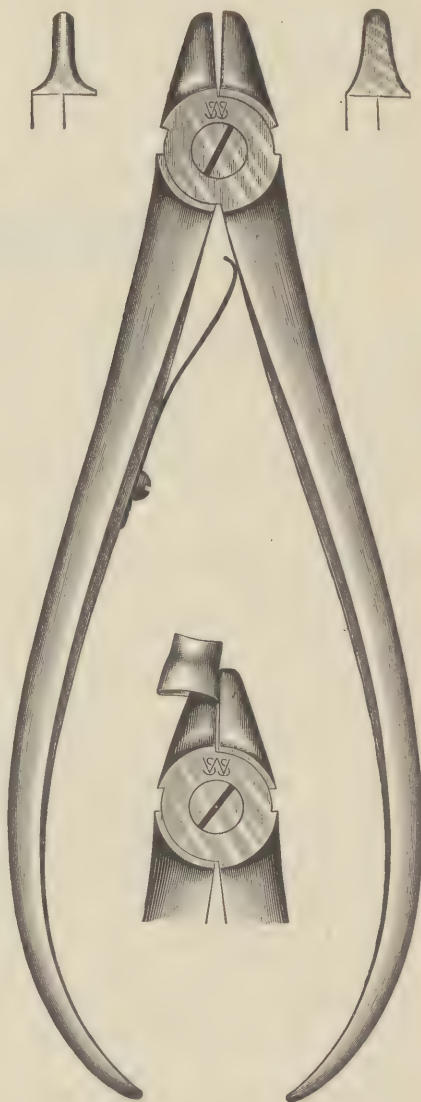


FIG. 242.

Class A, Dies

Method No. 1.—The superior molar to which a collar has been fitted, illustrated in Fig. 245, will be used as a typical case. The collar is removed from the mouth, warmed and the inner surface veneered

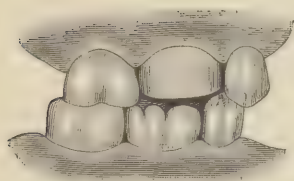


FIG. 245.

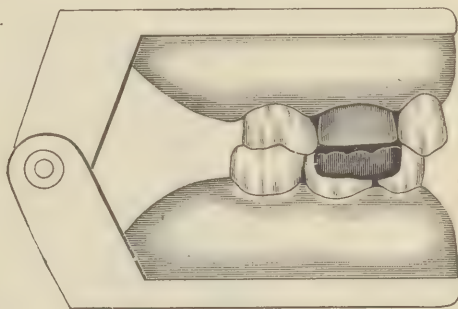


FIG. 246.

with a film of wax to facilitate its subsequent removal. It is then readjusted in the mouth, a wax "bite" taken and then a compound or plaster impression that will remove the collar in position. (See Part I, Chapter IV.) Next articulating models are made, using a crown articulator, and the models varnished. Burnish layers of tin foil to

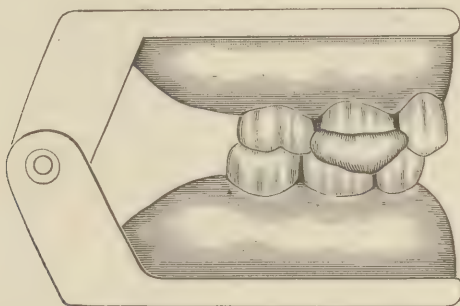


FIG. 247.

the thickness of the gold plate that is to form the cusp-cap over only the surface of the teeth, or portions of the teeth, that will antagonize the cusp-cap as indicated in Fig. 246.

The form of the occlusal surface of the crown to be swaged is made by placing in the occlusal section of the collar a ball of soft plaster, wax

or compound slightly in excess of what is required for the cusp-cap and firmly occluding the models together, Fig. 247. When the material has hardened, open the articulator and remove the surplus with a sharp knife. The impression of the antagonizing teeth will give an outline of the required occlusal surface. Allowing for the lateral movements

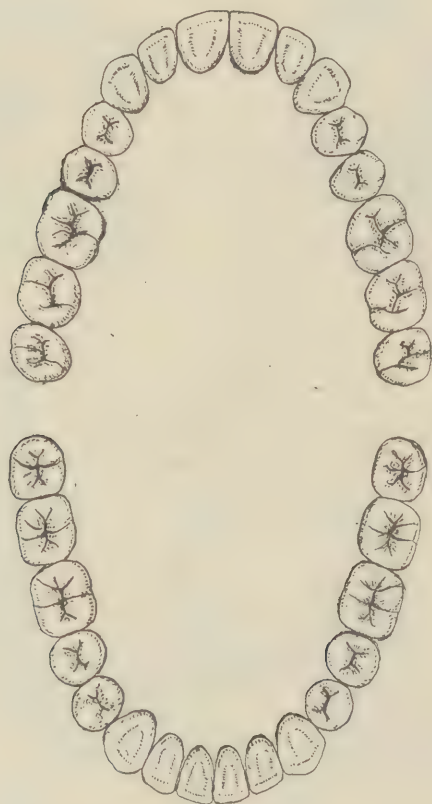


FIG. 248.

of the occluding teeth, carve the cusps, sulci and grooves, to as nearly the natural form as the circumstances will permit. Typical forms of occlusal surfaces can be used as a guide (Fig. 248). As the gold cap will strike up the thickness of the plate larger and the cusps that much longer, an allowance is made for that by the tin foil which was placed on the surfaces of the antagonizing teeth when they were occluded on the plaster (Figs. 246 and 247), but the material is to be proportionately

removed at the sides of the collar, and its edge left exposed, as shown in Fig. 249, enlarged in Fig. 250.

An impression of the model of the occlusal surface extending about one-sixteenth of an inch beyond the edge of the collar is now taken in a copper tube with moldine (Fig. 249). Paper is wound around the tube and a fusible metal die cast (Fig. 251). (See Fig. 21.)

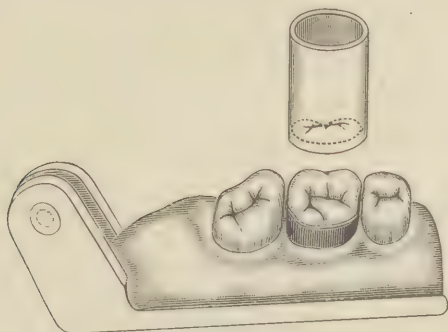


FIG. 249.

A counter-die is made by hammering the die into a block of lead (B, Fig. 252). To slightly enlarge the counter-die and make an allowance for the gold plate before swaging and thus avoid the chance of splitting it, cover the male die with a thin piece of kid and drive it into the counter-die.

Swaging the Cusp-cap.—Cut a disk of the same gold and gage as the collar, in size such as will leave when swaged a surplus of about



FIG. 250.

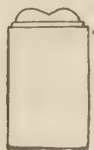


FIG. 251.

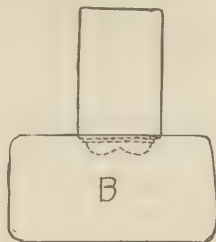


FIG. 252.

one-eighth of an inch at the edge of the cusp-cap; anneal the disk, oil or vaselin the surface of the die and counter-die and conform the disk to the surface of the depressions of the counter-die with a pointed piece of wood, by first pressing with the point and then tapping on the end of the wood; remove and anneal (Fig. 253).

To swage with the die and counter-die, place the die (A, Fig. 254) over the disk (B) and give the die a moderately hard blow, driving it



FIG. 253.

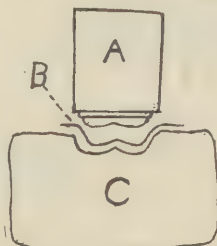


FIG. 254.

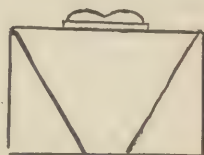


FIG. 255.

into the counter-die (C). Remove the disk and correct any folds around its margin, anneal and complete the swaging. Deep lines on the die representing sulci can be developed on the gold with the point of a burnisher.

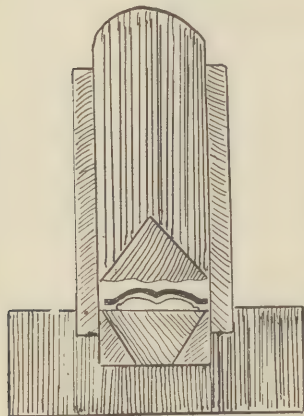


FIG. 256.

Stamping the Cusp-cap in a Swager.—In the use of a swager, the die of the occlusal surface is cast in a swager cup. The process is as follows: Flatten out a mass of moldine, remove the collar with the form of the occlusal surface from the plaster model and make an impression of the occlusal surface in the center of the moldine. (See Fig. 27, Part I, Chapter V.) Adjust the swager cup over the impression and fill it with fusible metal through the hole in the base. A cup with a cast die in it is shown in section in Fig. 255. The

disk of gold is annealed, placed in position on the die, conformed to its surface, removed and annealed. The gold is again placed on the die and covered with a disk of rubber-dam. The cavity in the plunger is filled with moldine, the swager cup inserted in the base and the plunger hammered down on the gold (Fig. 256); a soft rubber plunger may be used instead of the moldine. Fig. 257 shows the inner or cavo-surface of the swaged cusp-cap.

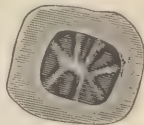


FIG. 257.

Reinforcement of the Cusp-cap.—Paint the outer surface of the cusp-cap with rouge or whiting. First melt on the corner of a charcoal soldering-block in the form of a globule the quantity of solder—hard

solder preferred—required to fill the cusp-cap, applying a moderate amount of flux. Next, place the cusp-cap, occlusal side down, in the middle of the soldering block, place the globule of solder in it and fuse the globule into the cusps. This is best done by first uniformly heating both cusp-cap and solder with the large flame of the blowpipe to nearly that of the fusing-point of the solder, and then reducing the blast and size of the flame (Fig. 258) to a small pointed one directed and steadily held on the globule until it gradually melts down and into the cusps of the cap. If necessary to heat up the gold of the cusp-cap during the operation, or at the finish to level the surface of the solder, apply only the large flame. Conducted in the manner described fusing of the

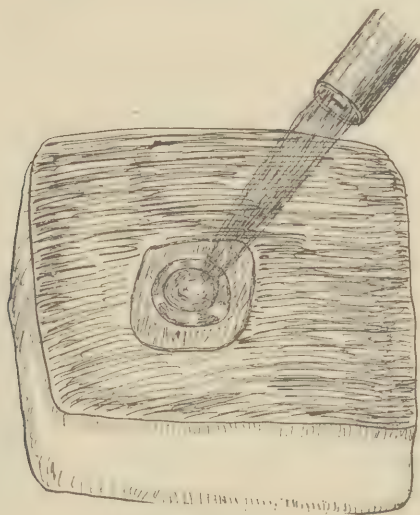


FIG. 258.

edge of the gold of the cusp-cap or flowing the solder over the edge on the outer surface of the cap, which is liable to occur if care is not taken and skill exercised, is avoided. Next boil the cusp-cap in acid and wash.

Fitting Cusp-cap to Collar.—Cut a piece of close-grained pine wood about six inches long, two inches wide and one and one-fourth inches thick and square and level the end. Heat the cusp-cap to a dull red and place and press it occlusal side down into the end of the wood level with the surface (Fig. 259). Thus embedded, file the surface of the cusp-cap and wood with a coarse flat file until the surface of the cusp-cap is uniformly level. Finish with fine files. The filing is most conveniently done by fastening the wood in a bench vise, as

illustrated in miniature in Fig. 260. Remove the cusp-cap, trim the plaster in the collar level to its occlusal edge, fit the cusp-cap to

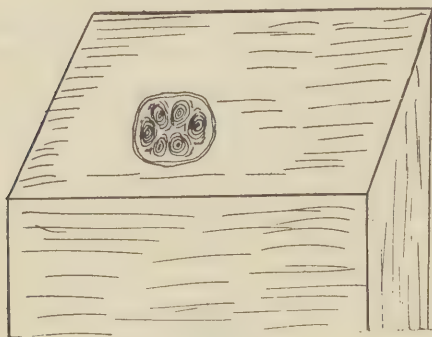


FIG. 259.

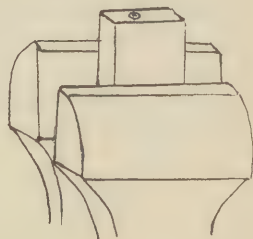


FIG. 260.

collar and return to wood block and again file until it fits perfectly in accordance with the occlusion.

To form a perfect and reliable joint, the cusp-cap should extend onto and slightly over the edge of the collar at all points. The edge of the collar must be square and evenly meet the flat surface of the cusp-cap over its entire circumference; otherwise, if used in bridge-work, the joint is liable to open in soldering the bridge.

Soldering Cusp-cap to Collar.—When fitted, the cusp-cap and collar are boiled in acid and washed. The edges of the collar and the flat filed surface of the edge of the cusp-cap are fluxed, placed in relative posi-



FIG. 261.



FIG. 262.

tion and clamped, occlusal side down, with an adjustable clamp (Fig. 261); or wired together with a piece of fine iron wire brought

across the cusp-cap and the ends twisted together over the edge of the collar, as shown in Fig. 262. Place around on the inside of the seam several very small pieces of fluxed solder, preferably the next lower-fusing grade to that used to fill the cusps. The crown—occlusal side down, with full view of the inside—is then held in a Bunsen flame and slowly, uniformly heated until the solder fuses and flows. Only sufficient solder to properly unite the parts should be used. If too much solder is applied, it is liable to flow over the inner surface of the cap and on the sides of the collar, or both, and obstruct the adjustment of the crown on the tooth, a defect troublesome to correct.

Swaged Cusp-cap Reinforced with 22-carat Gold.¹—Strike up the cusp-cap of pure or 2 per cent. platinized gold $\frac{4}{1000}$ gage, which doubled is about gage No. 32. Plate of this gage does not *materially affect the thickness of the cusp-cap like the use of* No. 30 gage; therefore very little if any allowance is necessary in shaping the model for the cusp-cap. Fill in the cusp matrix with coin gold as follows: Scraps of coin gold enough to fill the matrix are fused into a globule as already described; the globule is placed in the matrix, occlusal side down, and gradually heated and melted with a small blue flame steadily directed on the globule until it fuses and fills the matrix. No flux is applied. Considerable practice, as well as care, is required to successfully fill matrices of this character. Unite the cusp-cap to the collar from the inside by placing there a very small quantity of solder and flux and holding in a Bunsen flame; or use the sweating method.

Sweating.—When the cusp matrix is filled in with the same grade of gold as the collar and the crown is to be used as an attachment to a bridge, this is the preferred method of uniting cusp-cap and collar by many bridge-work specialists.

To Unite by Sweating.—The edge of the collar and surface of the cap must meet *at every point*. The collar and cusp-cap having been boiled in acid are fluxed and clamped, or wired together (Figs. 261 and 262), and held cusps down in a Bunsen flame so that the thick cusp-cap will be heated first. They are kept there until nearly at the fusing point. The entire crown is then lowered a little in the flame and held until the gold begins to melt and unites collar and cusp-cap, when they are instantly removed. This method requires practice. It should be first studied before trying it on a practical case. (See Fig. 44.)

Method No. 2, Hollow Cusps.—This form of a cusp-cap is for use when a sound or only slightly decayed bicuspid or molar is to be capped with gold, for instance, as an abutment for a bridge, and on account of

¹ This method of forming a cusp-cap and then sweating it to the collar is that practiced and taught by Dr. Peeso.

shortness of crown or some other reason, removal of the least possible portion of the occlusal surface is desired. The inner surface of the cap in such a case must necessarily conform more or less to the occlusal section of the tooth. If antagonizing teeth are present, enough substance *must be removed* from the occluding teeth or the one capped, or both, to allow for the intervening thickness of the plate forming the cusp-cap. In such a case fit the collar and trim enough off the occlusal edge of the collar to leave the cusps of the tooth exposed. Press a



FIG. 263.

ball of softened impression compound over the occlusal surface and the edge of the collar, allow it to cool and then remove the collar and compound together. Fill the impression inside the collar with plaster and when the plaster has set remove the compound. This gives a plaster model of the occlusal surface within the collar as in the mouth, as outlined in Fig. 263.

Take an impression or mold, make die and strike up a cap of gage No. 28 to 30, the same as in Method No. 1. Leave a slight overlap edge to the cap as it meets the outer edge of the collar. Remove the plaster from the inside of the collar and attach the cusp-cap to the collar on the outside with wax, flowing the wax over and into the seam. Fill the inside of the collar and cap with investment material and wire or clamp the cap and collar. Heat the investment slowly so as to burn off the wax and not displace the cap with steam from the investment. Holding cap and collar in position, unite them from the outside by flowing the least possible quantity of solder in the seam. The slightly projecting edge of the cusp-cap will retain the solder, which should be applied in very small pieces in position.



FIG. 264.

A variation of this method is to mark the outline of the occlusal surface on the inner surface of the collar, then remove the collar and trim so as to leave a border of about one-sixteenth of an inch outside

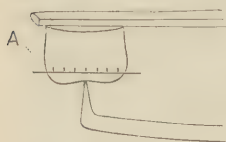


FIG. 265.

the mark. This border is then thinned with a carborundum wheel, and slit, as seen in Fig. 264. The collar is next adjusted on the natural crown and the slit border bent over to the form of the occlusal surface, to which it is burnished.

A cusp-cap stamped with a die of the occlusal surface or one closely approximating it is then adjusted on the collar in the mouth, the occlusion of the cusp-cap tested by occluding the teeth, and the cusp-cap and collar removed. They are then clamped, as shown in Fig. 265, and the cusp-cap

fastened only at the point A with an atom of solder. The crown is then readjusted on the tooth and the edges of cap and collar brought together with a foot-shape foil condenser, also by occluding the teeth, if any are present, and the soldering completed by degrees. In such cases as described, if the antagonizing teeth are present, the cusp-cap is preferably made of platinized gold (clasp gold) to better resist the wear of mastication.

Class B, Intaglio or Depressed Dies

Method No. 3.—Form on the collar the required cusp-cap in plaster or metalline¹ and embed the collar—cervical end down—in a flattened lump of moldine exactly to the line of junction of

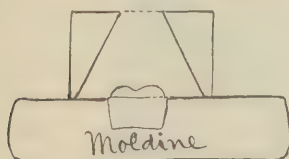


FIG. 266.

the gold collar and cusp-cap model (Fig. 266). Place the swaging cup of the swager over it and pour in fusible metal. When chilled, remove crown and moldine and vaselin the

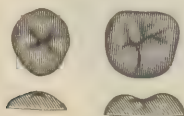


FIG. 268.

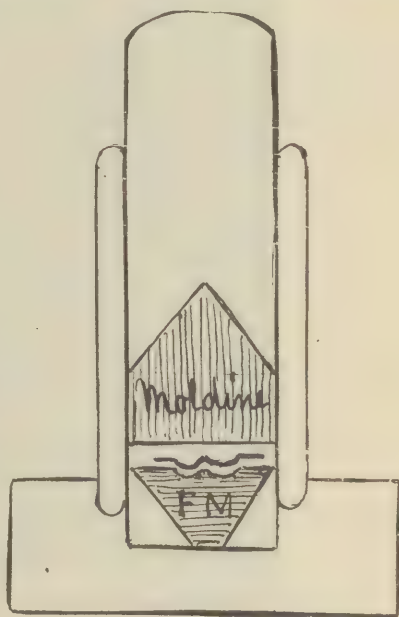


FIG. 267.—FM, Fusible Metal.

surface of the die, then start the gold plate into the depressions with the point of a piece of wood by tapping on the end. Remove, anneal and replace the gold, insert the cup in swager and complete the swaging with the plunger (Fig. 267).

Method No. 4, Cusp-buttons.—This consists in the use of solid metallic models of the occlusal surfaces of bicuspid and molars to form intaglio cusp-cap dies for crowns or pontics (Fig. 268).

¹ A mixture of carbon and impression compound sold for such purposes.

Cusp-buttons are made by stamping sheet copper, gage No. 36, to the form of an occlusal surface and filling the matrix with lead or tin by fusing it in a Bunsen flame, using zinc chlorid as a flux. The surface is then filed perfectly level by rubbing on the surface of a flat file. The buttons should be arranged in sets on wax in a tray so that the required form or size can be easily selected, as shown in Fig. 269.

Application.—Fit the collar and select a cusp-button. Remove enough of the occlusal edge of the collar to make room for the cusp-button and file the edge of the collar perfectly level. Place a little wax inside the collar to assist in retaining the cusp-button in position.

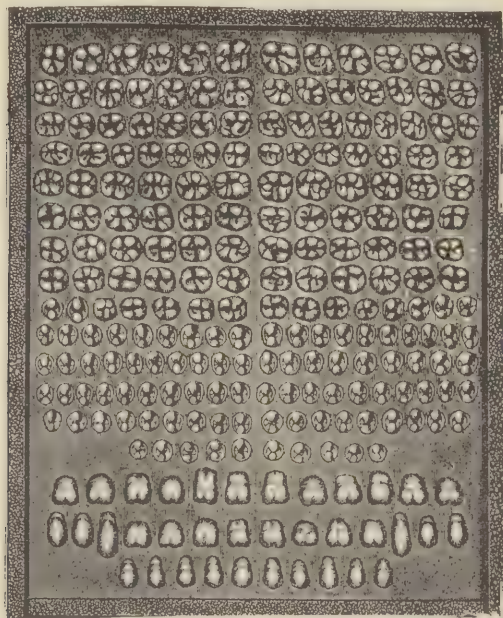


FIG. 269.

The cusp-button selected should be fully as large as the circumference of the collar, should articulate properly and correspond in shape with the other teeth. Remove the button and place it on a level cake of moldine—occlusal side up,—cover it with a swager cup and flow in fusible metal (Fig. 270). When cool, remove cusp-button, place the gold plate over the intaglio or depressed-die and swage the gold into the die with the plunger. This gives a cusp-cap of the exact form and size of the cusp-button the gage of the plate smaller on its cavo-surface.

If among the cusp-buttons on hand none articulates perfectly, the difficulty is usually remedied by taking the button which most

nearly answers and building up the cusp with moldine (Fig. 271). If a collar is accidentally cut too short, it may in some cases still be utilized. Place moldine upon the molding plate, set and adjust

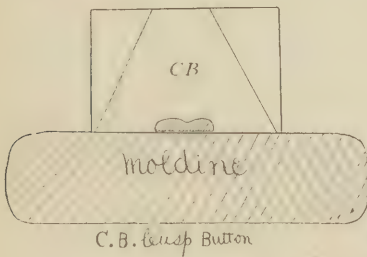


FIG. 270.



FIG. 271.



FIG. 272.

the cusp-bottom upon it, press and cut away the moldine from around the edge of the cusp-button to deepen the form of the cusp-cap enough to make up the deficiency of the collar (Fig. 272). This will, of course, throw the soldering line a little farther up around the crown.

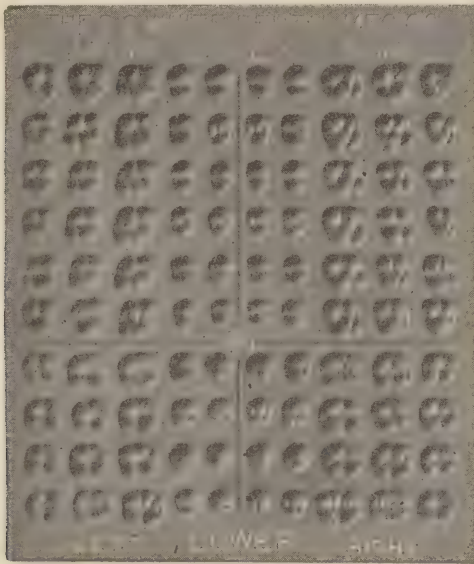


FIG. 273.

To Enlarge a Cusp Button.—To make a cusp-cap the thickness of the gold plate larger, fill the swager cup with impression compound and level the surface. Lay the cusp button—occlusal surface upward—on the center. Place and swage the gold plate over the cusp button.

Method No. 5, Intaglio Die from Wax Model.—Shape the model of the occlusal surface on the collar with stiff plate-wax. Fill a swager cup with impression compound and level and warm the surface so that it is quite soft. Oil the wax model lightly; chill with cold or ice-water, press into the surface of the warm compound to the line of the occlusal edge of the collar and immediately chill the compound by immersing in or placing under running water. If properly done the heat of the compound will not at all disturb the wax form. Remove the wax model. This gives an intaglio die of impression compound into which can easily be swaged pure gold, gage No. 38, and even 22-carat gold by frequent annealing.

Paint the outer edge of the swaged gold form of the cusp-cap with rouge, place it on a soldering block and with a blowpipe melt into it globules of hard solder or coin gold until it is full. A satisfactory cusp-cap is quickly made by this method.

Intaglio Die-Plate.—Intaglio die-plates (Fig. 273) of the occlusal surfaces of bicuspid and molars are manufactured and sold for use in forming cusp-caps. They are not as convenient to use as the cusp-button method, as the latter permits the required form and size to be more easily determined.

Class C, Casting

Method No. 6, Solid Gold Cusp-cap.—Casting is the preferred method for cusp-caps. Form on the collar a model of the required cusp-cap with inlay wax, with the collar in position or mounted on a model, as described in Method No. 1, using wax instead of plaster. Have the inner edge of the collar slightly embedded in the wax. Chill and remove the wax cusp-cap model, invest and cast. The sprue is inserted in the thickest part of the wax before or after its removal from the collar, as shown in Fig. 47. The wax model of the cusp-cap may be invested in position on the collar and cast directly on it. In such a case wax not necessary to the cusp-cap should be removed from the inner surface of the collar to insure easy adjustment of the finished crown.

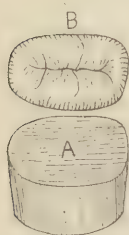


FIG. 274.

This method is further varied by capping the occlusal end of the collar with a floor of thin gold plate or 1/1000 platinum (A, Fig. 274) and shaping the wax model of the cusp-cap on it. When the cusp-cap is cast (B) clamp and solder it on the floor of the collar.

Special Methods

Method No. 7, Solid Cusp-cap by Soldering.—When intervening space will permit the formation of a solid gold occlusal surface to a collar crown the following is a practical method: Fit the collar and trim the edge toward the occlusal surface so as to leave between it and the cusps of the occluding teeth a space of at least one-sixteenth of an inch. Remove the collar and cap the occlusal surface with a floor of gold plate about gage No. 30, using a very small quantity of hard solder to unite it to the collar. Trim off the surplus plate flush with the collar.

To form the cusps, melt scraps of gold plate on the surface of a soldering-block into small globules, one for each cusp, and slightly flatten each globule on an anvil with a hammer. Place the globules on the surface of the cap in proper position to form the cusps and attach each with a small piece of hard-flowing solder or solder filings (Fig.

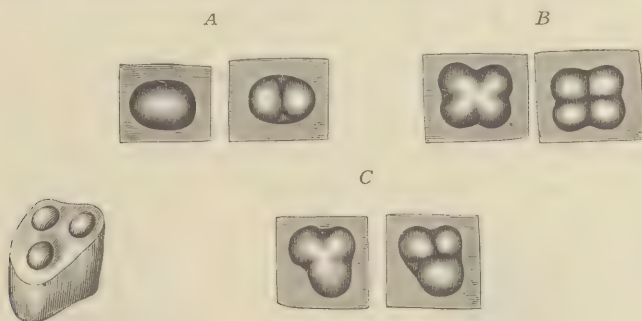


FIG. 275.

FIG. 276.

275). When all the cusps are attached, add sufficient ordinary solder to properly fill in and give form to the surface of the cap. Adjust the cap in the mouth and trim the gold of the occlusal surface to the form that will suit the occlusion, then polish the crown. This is a very practical and quick method of forming a gold crown, especially in a case of mechanical abrasion and short cusps.

Method No. 8.—When the mere form of the occlusal surface for the crown is all that is required, as in cases of mechanical abrasion, or for a temporary crown, an impromptu one may be made by indenting a piece of pure or soft gold plate with the round end of an instrument handle on a piece of lead to form the cusps, then reverse the cap, resting it on a flat surface, and creasing between the cusps with a burnisher. One large indentation, such as is shown at A, Fig. 276, which when indented and creased across the center with the edge of a flat thin

burnisher will represent a bicuspid; four indentations closely made, as shown at B, when creased between, can be used to represent an upper or lower molar, and three similar indentations, properly creased, a second or third upper molar, as seen at C.



FIG. 277.

All-Gold Crowns for Incisors and Cuspids

When the teeth are abraded and short, with flat incisal edges or occlusal surfaces (Fig. 277), and the all-gold crown required is to correspond in form and be only a little longer, the tooth is first trimmed and



FIG. 278.

properly shaped. The gold collar, after being fitted to the cervical section, is slit on the lingual side and bent and burnished against the tooth. The collar is then removed and the seams soldered together. This is best done by holding the collar in a Bunsen gas flame with the solder placed in position in very small pieces and only sufficient in quantity to join the seams. The collar is next adjusted to the tooth

and the gold at the incisal edge is evenly removed enough to furnish space to form that section. A flat thick piece of gold plate or clasp gold, as heavy as 22 gage, or No. 30 gage additionally reinforced, is soldered across the incisal edge to form and inclose that portion of the crown.

Cases of Abrasion.—Fig. 277 represents a case of abrasion of the lower teeth to which all-gold crowns were applied to open the “bite,” as shown in Fig. 278. In such cases, owing to the attrition of the occluding teeth, the cap forming the occlusal surface should invariably be constructed of heavy gold clasp plate of one or several layers and solder as the case permits or suggests. One or two holes punched through each piece as it is applied facilitates their union with the solder. (See Fig. 445.) In these cases the occlusal third should be formed to knuckle very closely to protect the gum septum in mastication. An artificial plate replaced the upper teeth in the case illustrated.

In a case such as this the patient is usually advanced in years. In their treatment the opinion of most practitioners is, that only a partial restoration of the teeth in length is advisable. An operation for a young patient would be under different conditions and would not be included in this opinion. In persons of advanced years the sockets of teeth artificially lengthened do not always readily accept the sudden change respecting leverage and force of occlusion.

To gage the space to open the “bite,” the best method is to first crown a tooth on the right or left side or on both sides with an extra thick occlusal surface, then insert and trim to the length required, which will furnish the proper gage for the others.



FIG. 279.

Gold crowns to be given a normal form require the fitted collar to be cut away at the lingual section, as shown in Fig. 279. The edge of the gold is then chamfered, bent and burnished over the incisal edge and sides close to the natural tooth. To this open section is next adapted a curved piece of gold plate, the collar is removed and the parts are soldered together, using only a small quantity of hard solder. Small pieces of ordinary solder or solder filings can be melted in the interior of the incisal edge to resist attrition. A fusible metal die of the prepared form of the natural tooth is a material aid in the construction of any of these styles of crowns.

In pulpless teeth with only a little or none of the natural crown remaining, the root can be shaped and capped the same as for a collar crown with a porcelain facing, with a post in the root-canal. A gold facing is then applied instead of one of porcelain. This is done by shaping or stamping the form of the labial face of the tooth required in

gold plate, filling it with hard solder, mounting it in position on the cap, as in the case of a porcelain facing, and attaching and giving any necessary shape to the lingual side with ordinary solder.

To make an intaglio die to shape a gold facing, select a suitable sized porcelain tooth, place it face upward on a flat piece of moldine, place the swager cup over it and cast in fusible metal. (See Fig. 28.)

The construction of an all-gold cap-crown for an incisor or cuspid is most easily accomplished by the seamless method described in Chapter X.

CHAPTER VIII

GOLD COLLAR CROWNS WITH PORCELAIN FACINGS

This style of crown, for incisors and cuspids, as originally made by Dr. C. M. Richmond and with which his name is commonly associated, originally consisted of a cap for the root formed of a band of gold with a platinum floor on which was soldered a tooth with a slot in the center between the pins. Through this slot and the center of the cap a screw passed, which entered into a cylinder previously screwed and cemented into the root-canal.

The form of gold collar crown with porcelain facing now in general use is in principle the same as what was formerly known in dentistry as a gold pivot tooth, with the addition of a gold collar for the root and having the advantage of zinc-oxyphosphate for its cementation. These improvements enhance its value as a crown and materially change the process of its construction.

Incisors and Cuspids

Adaptation of the Collar.—In making an incisor or cuspid crown of this style the root-canal is treated, the root shaped and a collar made and fitted as described in the preceding chapters. The collar is held in position on the root, a sharp-pointed instrument introduced inside the collar, and the line of the surface of the root scratched on the metal around the circumference. The collar is removed and trimmed a trifle flush to this mark with small pointed shears. It is then adjusted on the root and the edge of root and collar ground even, removing some of the surface of the root if necessary for this purpose. In the operation of grinding, the collar should first be firmly held in position on the root at the labial side while the lingual section is ground, then at the lingual while the labial is being reduced. At the labial section, the collar and surface of the root should be removed so as to be invisible if the patient exposes the gum-margin in speaking or laughing. To positively insure such a result in the finished crown, it is advisable to first grind and shape the end of the root and the base of the porcelain facing, the one to the other, with the collar removed, making an allowance for

the thickness of the floor of the cap. In cases where there is no exposure of the gum-margin in the movement of the lips, a proportionate amount more of the collar and root may remain. This is often desirable, as it affords additional strength, especially when the crown is to be used as an abutment in bridge-work. The work then will present the appearance about the collar shown in Figs. 280 and 281.

As the sides of the collar are parallel with the line of the cervical section of the root, the edge of the collar at the lingual side forms an angle with the surface of the end of the root (A, Fig. 280). In close occlusions this is liable to give a conformation to the finished crown



FIG. 280.

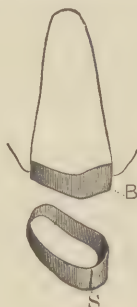


FIG. 281.



FIG. 282.

at that point quite perceptible and objectionable to the patient. This can be avoided by slightly rounding off the lingual side of the root to the form illustrated at B, Fig. 281. The collar is then slit two-thirds across, as outlined at S, the edges beveled slightly, lapped, fitted on the root, pressed and burnished to form and soldered. In the finished crown the collar will then present a form nearer that of the natural tooth, as illustrated in Fig. 282.

To Form the Floor of the Collar.—The floor of the collar that completes the cap is made of gold gage No. 30 or thin platinum plate gage No. 38 to 40. Thin platinum plate or $\frac{1}{1000}$ platinum foil is preferable when it is desirable to have the least possible space occupied by the floor at the labial section. The thinness of the platinum forming the floor to the cap does not materially affect the strength of the finished crown, as that part is reinforced by the solder subsequently applied. When the cap is for a removable tube and split-post crown, the floor is to be made of the same grade of plate as the collar, gage No. 28.

A piece of the gold or platinum plate is cut—square or round—considerably larger than the circumference of the collar. The outer edge of the collar having been filed level is placed against the floor and

adapted to its surface by slight pressure between the fingers. With the collar resting on the floor, the edge is seized with a clamp, a piece of solder with flux is placed on the gold or platinum outside of the collar, as shown in Fig. 283. The whole is then held in the flame of a Bunsen burner, the solder fused and collar and floor united. The quantity of solder applied must be very small, barely sufficient to unite the parts, so that it shall not flow over the inside of the cap and interfere with its fit on the root. All parts of the edge of the collar should touch the floor before they are soldered; otherwise, in subsequent soldering, the seam is liable to open. Perfection in this part of the work is most easily attained by first attaching the gold or platinum to the edge of the collar at one point with a mere particle of solder to retain and hold it in position, and then readapting the remainder of the edge and completing the soldering.

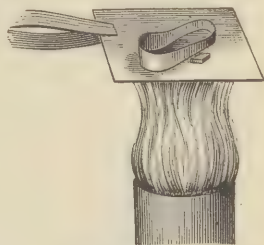


FIG. 283.

The position of the tweezers should be changed during the soldering, as they conduct the heat from the metal at the point held. When the collar and floor are united, the edge of the plate forming the floor is to be trimmed flush with the outline of the collar with small shears and finished smooth with a carborundum point. At the cervical edge, in some cases, it is well to have the floor extend slightly beyond the collar so as to accommodate proper alignment of the facing in a labial direction and to assist in shaping the collar with solder at that point later on.

The cap is next adjusted on the root. Should any part of the cap not seem to fit in position accurately, a foot-shape foil condenser pressed or malleted along the edge of the collar at the part soldered to the floor will correct it, if the soldering has been properly conducted. Pressure is next exerted with the finger on the palatal side of the cap to retain it in position while the labial section of both floor and collar is burnished to the root. This adaptation steadies the cap on the root. The cap is then ready to receive the post.

Indirect Method.—If this method is practiced in forming a collar and floor on a die (Part I, Chapter V), swaging should be omitted, as it distorts the position of the collar. Swaging is best applied to seamless root-caps. (Formation of Cast Root-Caps is described page 207).

Preparation of Canal to Receive Post.—In a collar crown of the style described, the collar is largely relied upon for retention on the root, and the post is therefore not usually so important a part as in a crown where a partial collar or no collar is used. To receive the post, the root-

canal is first opened up with Gates-Glidden drills and then with suitable reamers enlarged to the size of the intended post (B, Fig. 284). The orifice of the canal should be countersunk a little with a large round bur to give it a slightly cup-shape form. Into this depression the gold or platinum of the floor of the collar can be burnished with a cone-pointed burnisher. The object of the depression is to provide a space to flow the solder in around the post to reliably attach it to the floor, especially should conditions require that the end of the post be ground off close to the surface of the floor (Fig. 285, in section).

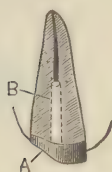


FIG. 284.



FIG. 285.



FIG. 286.

Post.—Gold clasp or iridio-platinum wire, preferably round, gage No. 14 to 18—a little smaller for laterals or other roots which require its reduction—is used for posts.

The use of posts made of alloys of the base metals is to be condemned for this and all styles of work. The wire for the posts may first be rolled under a flat file to roughen its surface. It should be slightly rounded or tapered at the point and introduced one quarter of an inch, more or less, up the canal, as indicated by the conditions of the case respecting length of root, size of artificial crown to be mounted and character of the occlusion (Figs. 284 and 286). A large, long crown, or a close occlusion, suggests a longer and heavier post than a small or short crown or a more favorable occlusion. If the canal is for any reason much enlarged, the point of the post should be tapered and extended to its extremity in order to strengthen the root as well as anchor the crown. When gutta-percha is used to attach the crown, a longer post is required than for zinc oxyphosphate, and the post should fit the canal in such a manner as to require the presence of only a very small quantity of gutta-percha to secure it (Figs. 286 and 288).

Union of Post and Cap.—The post having been fitted, the cap is adjusted on the root, the floor over the canal is burnished into the orifice and punctured. The end of the post is seized with wire pliers and the point inserted and forced through the puncture in the floor to position in the canal, and the correctness of its relations with the cap observed

and decided. Cap and post are next removed, dried, slightly heated, and the surface of the floor and exposed end of the post veneered with adhesive wax. The cap and post are again adjusted to position on the root, protected from moisture, and a small pellet of slightly heated wax is placed over the end of the post and pressed against the surface of the cap and around the post. The wax is chilled with water and the cap and post carefully removed and invested. The investment material should be run into the interior of the cap so as to fill every crevice. When set, the wax is removed by pouring on boiling water and the investment is trimmed and reduced to as small a size as permissible (Fig. 287). It is next heated and solder flowed into the depression around the post flush with the surface of the cap, also over the surface of the floor at the lingual side, if made of thin platinum. Should any extensive aperture exist in the gold or platinum around the post at the orifice of the canal before soldering, a pellet of gold foil or Corona gold may be gently pressed in the place to aid the solder in filling it up. After removal from the investment and boiling in acid, the cap and post are adjusted in position on the root.



FIG. 287.

Selection and Adaptation of the Porcelain Facing.—The adaptation of the porcelain facing to the cap is next made, either directly in the mouth, or by the aid of a model of the case. When a model—which is the preferable method—is to be used, the impression and bite are best taken together in plaster or impression compound or the bite can first be taken in wax, then the impression in either plaster or impression compound. The impression and “bite” are best taken together if the shape of the teeth permits easy removal. To permit easy removal of the cap from the model during its construction, a veneer of paraffin should be placed with a heated spatula around the inner surface of the collar and on the sides of the posts. (See Fig. 18.) A plaster or artificial stone model is made, the wax “bite,” if separate, adjusted on it and an articulating model made.

The projecting end of the post is cut off with a thin carborundum disk a little above the surface of the floor. The end of the post is next reduced with a carborundum wheel to the surface of the floor at the labial side, but left slightly projecting above it lingually for additional strength, should such a form offer no obstruction to the setting of the porcelain facing (B, Fig. 288).

The porcelain facing is formed of a cross-pin plate tooth. The shade selected should be at least as dark as that of the opposite corresponding natural tooth, if present, or if absent that of the adjoining teeth. The general form, while suitable in appearance, should be such

as will permit proper adaptation without excessive reduction by grinding. The curve of the sides toward the base should be such that when the facing is ground the base will not greatly exceed the surface of the cap in width, and the pins be so located that their strength will not become impaired in the required removal of the porcelain for the proper adjustment of the facing.

There are two methods of setting the porcelain facing to the cap. In the first method the facing is ground to position with the base of the porcelain closely fitted to the surface of the cap (Fig. 289).

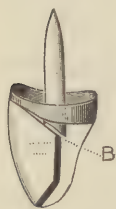


FIG. 288.



FIG. 289.



FIG. 290.

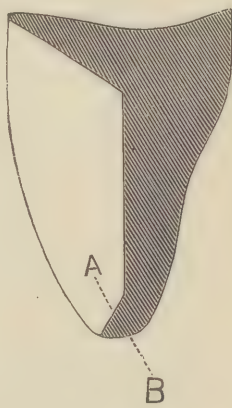


FIG. 291.

In the second method the facing is fitted at the cervico-labial section to rest on the cap while the remainder of the base is ground so as to form a slightly increasing space toward the lingual side just over the post (P, Fig. 290). As the porcelain rests on the cap at only one point it simplifies the work of correctly positioning the facing with the other teeth. The facing should be ground so as to locate the pins about in the center of the facing for strength. (See Fig. 289.) The cervico-labial edge of the facing should be placed even or flush with the edge of the collar. When a model is used to fit the porcelain facing, although it facilitates the operation, the exact alignment of the facing should be determined by a final adjustment in the mouth.

To Protect the Incisal Edge of the Porcelain Facing.—To protect the incisal edge of the porcelain facing against fracture in such a manner the gold will be invisible, the porcelain should be ground and beveled off at an angle of about 45 degrees to the incisal edge at a proper distance from the pins, as shown in Figs. 288, 289 and 290, and also at A, Fig. 291. In grinding and polishing the porcelain, revolve the wheel in the direction shown in Fig. 302 to avoid chipping the enamel.

Polish the edge with fine sandpaper disks. In the final finishing the gold is brought on a straight line, or nearly so, with the edge of the

porcelain, as shown at B, Fig. 291. By this plan the porcelain is protected and the gold rendered invisible when viewed from the front.

Backing The Porcelain Facing

One-Piece Backing.—When the porcelain facing has been fitted to the cap by the aid of a model, it is best to retain and define its position on the cap before removing it for the application of the backing, by forming a removable matrix of plaster on the labial aspect, as shown in Fig. 292. This permits removal of the facing and insures its replacement when backed in exact position on the cap. The backing of the facing must be absolutely adapted to the surface of the porcelain to afford strength and continuity of structure and prevent intrusion of secretions or extraneous



FIG. 292.

matter in use. To effect this the porcelain facing before backing should be first divested of every particle of wax by immersing in boiling water. The edge of the backing should be flush with the edge of the porcelain on the sides to draw the solder and permit finish. The backing should never be rounded or looped over an edge of the porce-



FIG. 293.

lain. The backing is made of platinum, gage No. 38, or crown metal, which is platinum on one side and gold on the other, or of 24-carat pure gold plate, gage No. 30 to 31. Gold imparts a slightly yellow and platinum a bluish shade to the porcelain; so the platinum or gold side of the crown metal can be placed accordingly.

When the entire base of the porcelain facing is fitted to rest on the floor of the cap according to the first-mentioned method, the backing is applied to extend from the base to and over the trimmed incisal edge, as shown in Fig. 289. If the facing is fitted according to the second method with a V-shaped space at the lingual side of the base, the backing is extended to also cover the base, as shown at P, Fig. 290. To ascertain the exact position of the pins, the plate is placed on a flat wooden surface or a piece of cork, the pins are made perfectly straight and the facing placed over the plate, pins downward, and enough pressure applied to make a slight indentation (Fig. 293). Holes are now punched through the indentations with punch forceps and the backing closely adapted to the surface of the porcelain by annealing and burnishing.

Pointed-Pin Facings are intended to punch their own holes through a backing of moderate gage by pressure. This simplifies the operation of backing and forms a flux-tight joint between pins and backing that prevents solder from flowing through and checking the porcelain, which is liable to occur when the pin-holes in the backing are loose or open. Fig. 294 illustrates this form of facing.

Flat-Pin Facing.—Fig. 295 shows a flat-pin facing. In this form the pins are bent down on the backing.

Use of Swager.—An assured adaptation of a backing to a facing is obtained by placing the facing, labial aspect downward, in impression-compound in a swager cup (Fig. 296), and swaging the backing against the porcelain. To avoid fracture, the backing should first be burnished, then annealed and not too much force applied.

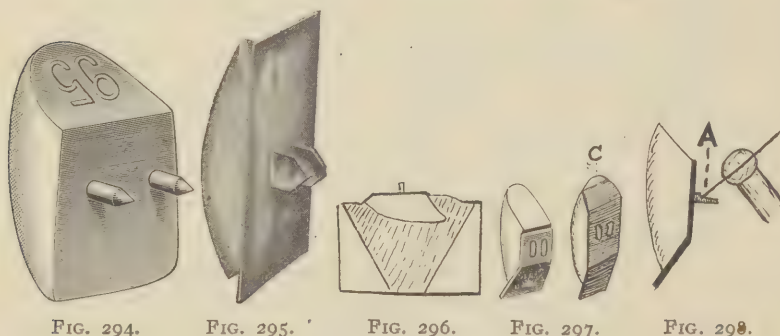


FIG. 294.

FIG. 295.

FIG. 296.

FIG. 297.

FIG. 298.

When the backing is adapted, the pins are bent down on the surface in either of the positions shown in Fig. 297. When bent towards the incisal edge, they assist in retaining the solder in position, in soldering and thickening the backing at that point. The backing is trimmed straight to the sides of the porcelain except at the incisal edge, where it is left extended, as shown in Fig. 297. This extension is removed to the edge of the porcelain after the crown is soldered.

Removal of a small portion of the pins on the side they are to be bent (A, Fig. 298) with a stiff sand-paper disk will permit them to be bent downward on the surface of the backing with less strain upon the porcelain. The backing should be in position on the porcelain when the pins are trimmed to avoid their removal below the line of the surface of the backing; preferably they should be trimmed a little above it.

Preparation for Investment.—The porcelain facing when backed is adjusted on the cap. Should the metal backing on the base of a facing

in the second method interfere with its proper adjustment on the cap at the cervico-labial section, as is generally the case, it should be thinned with a small carborundum cone or entirely removed at the obstructing point, as indicated at C, Fig. 297, and that portion of the porcelain allowed to rest directly on the cap. The facing is first attached to the cap with only a small quantity of adhesive wax until its alignment is quite accurately determined, then hard wax is added to more securely retain it. The whole is chilled in cold water and a final adjustment made in the mouth to positively assure its correctness. Before investing, additional wax is added to the metallic parts of the crown to be soldered, sufficient to impart to them the desired form for the solder and allow a slight excess for finishing. A little wax is generally placed on the sides of the collar at the cervical section of the porcelain facing, especially when any portion of the porcelain projects over the line of the collar, for the purpose of providing space in the investment for the solder to flow and contour the part, as shown in Fig. 299, which illustrates the waxed-up crown ready for investment.



FIG. 299.

Investment.—Calcined marble-dust or fine silex and plaster are the preferred materials for investment. They are used in the proportions of two parts marble-dust or silex to one of plaster. First thoroughly mix the dry ingredients, then add the water. The crown is

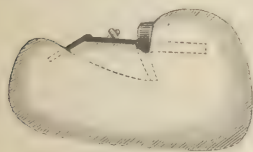


FIG. 300.

first wet by dipping in water and then the inside of the cap is filled with the investment material. A small camel's-hair brush will facilitate this; also the use of a hand air-syringe to blow the investment into the interstices. A portion of the investment in the form of a small mound is next placed on a

sheet of paper and the crown is gently pressed into it until all the parts are covered except the wax on the lingual side of the backing.

When the investment has set, the wax is removed by pouring boiling water on the investment. Instruments should not be used to remove wax as they are liable to disturb delicately adjusted parts. The investment is next trimmed and reduced in size as much as it properly can be, and the investment material removed so that the metallic parts of the crown are slightly exposed at the sides, as shown in Fig. 300, for the first described method of fitting a facing, and in Fig. 301 for the second method, to fully expose the V-shaped space. Borax, finely ground and mixed with water or liquid flux, is applied with a brush to the metallic parts and in the seams before heating.

When Parr's fluxed wax is used for the benefit of the flux it contains, the wax is allowed to burn out as the investment is heated. The objection to burning wax out is that it does not leave as clean a surface of metal to solder.

Soldering and Finishing.—The investment should first be dried and then heated to a dull red over a Bunsen flame (see Fig. 29), and removed to a soldering-block. Gold solder cut in small pieces in quantity only sufficient to fill interstices and unite the facing to the cap is first placed in and over the space between the facing and cap. The solder should have been previously immersed in borax finely ground in water and then dried, or, after it is placed in position, it should have a small quantity of calcined borax sprinkled over it.



FIG. 301.



FIG. 302.



FIG. 303.

Solder is also used in strip form, as it can be more rapidly applied and the application instantly stopped by withdrawing the strip. Soldering of places difficult to reach is facilitated, as illustrated in Fig. 305. Heating the investment uniformly, especially underneath, and in the direction indicated by A, Fig. 301, with the deoxidizing section of the large flame of a gas blowpipe will cause the solder as it melts to gradually flow downward into the interstices. More solder is added by degrees and fused in this manner with some use of a smaller flame directly applied to the gold until the spaces between the porcelain facing and cap and at the sides are filled in and continuity of structure assured. After letting the body of the investment cool slightly, so as not to *draw back* the solder that has been already fused in the deep portions, additional solder is placed on the backing and cap, and with a small-pointed flame flowed over these parts. Only sufficient gold should be applied to properly contour the parts and allow for finishing. When soldered, the investment should be allowed to cool slowly. The crown is next removed and boiled in sulfuric acid, 20 per cent., to thoroughly remove the borax, and it is ready for finishing. In finishing, the movement of wheels and files in trimming and polish-

ing should be so directed that the edge of the metal adjusted to the porcelain is pressed against it, as is indicated in Fig. 302, showing the use of a wheel in reducing and trimming the surplus gold at the incisal edge. The finishing with sandpaper disks should be done in the same direction. Fig. 303 represents the completed crown.

When the porcelain projects beyond the edge of the collar at the cervico-labial section, as shown at A, Fig. 304, and the form will not permit of sufficient removal, as frequently occurs in the case of cuspids, the space left should be evenly filled with gold solder when the facing is being attached to the cap. To accomplish this the backing applied to the base of the facing should be thinned or made of platinum foil (see PF, Fig. 309), and extended slightly beyond the edge of the porcelain at the cervico-labial section. The open space is filled and shaped



FIG. 304.

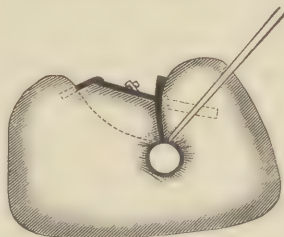


FIG. 305.

evenly with wax a little more than flush at the edge of the collar and extended backing. In such cases the flow of solder to the part is effected by forming a space on each side and through the investment which will expose it and permit solder to be applied directly, preferably in the form of a narrow strip, as shown in Fig. 305.

Diversity of Construction

Method of Forming Posts to Accurately Fit Canals.—To form a post that will accurately fit a canal, especially a canal that for some reason is considerably enlarged, slightly taper the point of a piece of iridio-platinum wire, gage No. 20 to 21, and a half inch long, fit it to the extremity of the canal and bend the end of the wire toward the labial side at a right angle to indicate its position when inserted (Fig. 306), and veneer the point of the wire with pure gold by fusing on it a pellet of gold foil. Cut a strip of platinum foil, gage $\frac{1}{1000}$, about one-eighth of an inch wide and an inch or more in length; bend the end of the strip of foil over the end of the wire close to the point and unite the wire and foil in a Bunsen flame. The veneer of gold at the point of the wire on fusing will be just enough to attach the strip (A, Fig. 307). Next wind

the strip around the wire, as shown at B, and insert in the canal. The coils of foil will press down on the wire in conformity with the size and shape of the canal, as illustrated at C. Seize the exposed portion of the foil and wire firmly with small-pointed pliers, remove in position and solder in a Bunsen flame with pellets of gold foil. Apply only enough gold to unite the layers of platinum, for if an excess is used the shape of the post will be altered and it will not fit the canal. The corrugations on the post formed by the layers of platinum foil afford an attachment for the cement.



FIG. 306.

Hollow Post.—This consists of a post with a small canal running through the center. The advantage it offers is the comparative ease with which it can be drilled out of the canal, if for any reason it becomes necessary to remove the crown, as the drill will follow the hole in the center of the post.

Construction.—Select the smallest carbon used for pencils¹ (A, Fig. 308). Heat and veneer the surface with a film of wax cement. Cut a strip of platinum foil $\frac{1}{1000}$, at least three-eighths inch wide and about an inch long. Warm the carbon enough to soften the veneer of wax and attach the end of the foil the same as to the platinum wire, as shown at A, Fig. 307.

Next wind the foil around the carbon (A and B, Fig. 308) and unite the layers of foil with pure gold. The carbon may be removed or allowed to remain. The gage of the post is regulated by the quantity of foil that is wound around the carbon.

A B



FIG. 308.

- A. Carbon.
B. Platinum foil wound around the carbon.

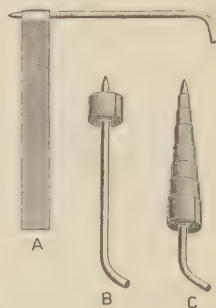


FIG. 307.

To Separately Back or Veneer the Base of a Porcelain Facing with Platinum.—This method consists in the use of a piece of platinum foil—instead of an extension of the backing—to cover the base of the porcelain facing when a V-shaped space exists between the porcelain and the floor of the cap, for the purpose of drawing the solder into the space so that

when in use the secretions will be excluded.

¹ The best method is to procure the hardest made drawing pencil, which is marked 8H, and remove a piece of the carbon about three-fourths of an inch long and trim it down in a chuck on the lathe to about No. 22 or 23 gage, which with care is easily done.

The process is as follows: The base of the facing is heated and its surface veneered with adhesive wax. While the wax is in a melted condition, a piece of $\frac{1}{2000}$ platinum foil is pressed against the wax with the finger or a tightly twisted ball of cotton with force enough to squeeze out the hot wax and bring the foil close to the porcelain (PF, Fig. 309). The base is reheated enough to soften the wax and pressure is again applied until the foil is brought against the porcelain. The surplus foil is cut flush with the porcelain and the facing is then mounted on the cap. Platinum foil is preferable to gold because less liable to melt and be absorbed by the solder. The foil at the extreme cervico-labial edge may be removed, as illustrated at C, Fig. 297, as in the case of a plate backing, and that portion of the porcelain permitted to rest directly on the floor. The crown should be invested as shown in Fig. 301.



FIG. 309.

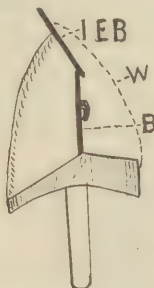


FIG. 310.

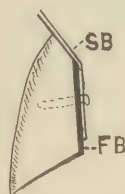


FIG. 311.

FIG. 310.—IEB, incisal edge backing; B, backing; W, wax to retain backing and facing on cap.

FIG. 311.—FB, first backing; SB, second backing.

Two-Piece Backing.—The one-piece backing previously described is the one most used. The two-piece backing is also in favor. The lingual surface of the facing alone or with the base is first backed with either pure gold, gage No. 30 or 31, or platinum $\frac{3}{1000}$, the pins bent and the backing trimmed to the line of the porcelain, as shown at B, Fig. 310. When the facing is mounted on the cap with wax ready to invest for soldering, an incisal edge backing of either gold or platinum is added and attached with wax, as shown at IEB. In the soldering, the backing to the porcelain facing is first soldered and connected to the cap, then the solder placed on the incisal edge backing and the two connected.

Reinforced Backing.—This consists of first adapting a backing to only the lingual or both lingual and base surfaces of the facing and then adapting another backing over the first which will also include the incisal surface. The first backing (FB, Fig. 311), is made of pure gold,

gage No. 32, or platinum plate $\frac{3}{1000}$ gage, closely adapted or swaged. The second backing (SB) of 20-carat gold plate, gage No. 26 to 30—the lighter the first backing the heavier the second—is extended from below the pins to and over the incisal surface. It should be carefully adapted by burnishing and annealing. Punching holes in the second



FIG. 312.

backing (E, Fig. 312), which is to protect the incisal edge (C) will permit the solder to flow to the first backing (D) and unite it in the soldering of the facing to the cap.

Another method is to remove the backings in position from the facing before investment, paint the under side of the first backing and

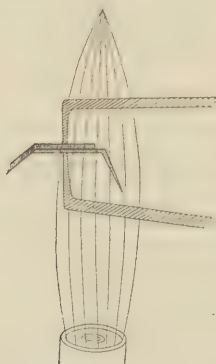


FIG. 313.

fill the pin hole with rouge or antflux. Next clamp the backings together, as shown in Fig. 313, and unite them with solder, using no more than enough to barely show at the edges of the seam. The double backing when adjusted on the facing will appear as outlined in Fig. 311.

CHAPTER X

GOLD COLLAR CROWNS WITH PORCELAIN FACINGS, CONTINUED

Bicuspids and Molars.—Bicuspids crowned by the method described for incisors and cuspids will have greater strength if a portion of the lingual section of the natural crown is preserved (Fig. 173), because of the support it will afford to the collar which will cover it.

The end of the root is capped after the manner of the typical central already described, one or two posts being used in the canals as required. Where only one post is used, it is best inserted in the lingual canal. If desired, a "bite" impression is then taken and models made. A



FIG. 314.



FIG. 315.



FIG. 316.



FIG. 317.



FIG. 318.

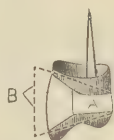


FIG. 319.

porcelain cuspid tooth, or a bicuspid facing is then ground, backed and adjusted on the cap to represent the labial aspect, and secured with wax. It is carefully adjusted in the mouth and the occluding edge of the porcelain ground to clear the antagonizing teeth (A, Fig. 314).

To Form a Cusp-cap.—A cusp-cap is made by one of the methods described at page 157. The preferable method—No. 6—is to form a wax model of the cusp-cap and cast it, especially if the occlusion is abnormal. When a cast cusp-cap is used, all or a portion of the coronal section of the crown to the floor of the cap may be additionally included in the casting, as illustrated in Fig. 315. A cusp-cap may also be formed by stamping a disk of pure gold, gage No. 34, with a suitably sized die (Figs. 316 and 317), or by the use of a cusp-button—Method No. 4—and reinforcing it with coin gold.

The cusp-cap when formed is trimmed (Fig. 318), ground and fitted to the occluding edge of the porcelain facing (Fig. 319), in proper posi-

tion as regards occlusion, and the wax attaching it is shaped to the contour of the crown (A). A piece of very thin pure gold plate gage No. 40 or $\frac{1}{2000}$ platinum foil (B) is adjusted on each approximal side of the crown, which is then invested (Fig. 320). The long ends of the side pieces of metal are designed to retain them in position in the investment so that the investment may be removed from the portion enclosing the sides of the crown (A). Mica (isinglass) may also be used as suitable for this purpose instead of gold or platinum. In the process of soldering the solder is placed in the aperture at B and the flame of the blowpipe directed under the investment, then on the exposed sides of the metal or mica at A. The solder is thus flowed into every part, forming perfect continuity of structure of the metallic portion of the crown. If the crown is short, leaving only a small space between the cusp-cap and the floor, the aperture at A may be left open without the gold or mica, and the solder first flowed in the interstices, as

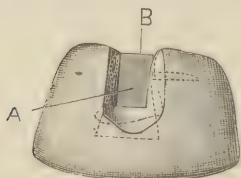


FIG. 320.



FIG. 321.



FIG. 322.

described (page 183) in soldering an incisor crown and the remaining solder necessary to contour the part can be then added if the pointed flame is used and not too much heat applied to the other portions of the crown and investment. In finishing, the surplus gold is trimmed to the contour of a bicuspid tooth. Fig. 321 represents the finished crown.

In difficult cases and occlusions the work is simplified by first soldering the porcelain facing to the cap. The crown is then adjusted in the mouth and the porcelain ground to properly clear the occluding teeth and allow space for the cusp-cap, and the work then completed as described.

This method of constructing produces a perfect and artistically formed crown, but simpler and quicker methods are practiced. One of these is to build up the palatal cusp with pieces of gold plate which have previously been melted into globules and flattened out on an anvil. These, laid in position and united with solder, are shaped in finishing to represent the lingual cusp (Fig. 322). The porcelain facing should be backed so that the solder can be flowed over its occlusal edge.

Another method is to extend the palatal part of the collar down, as shown in Fig. 323, and then fill in the space and form the sides and occlusal surface with solder. In finishing, the gold is trimmed to the form of the crown. As much as possible of the natural crown should be left at the palatal side of the collar, the exposed occlusal edge of which may be slit and brought in against the side of the tooth, and soldered to give contour. With this form of collar one post in the lingual root-canal is sufficient. The end of the post should be allowed to extend out of the floor of the cap enough to just touch the lower teeth when they are occluded. The exposed end of the post will be an exact guide as to the quantity of solder required to form the occlusal surface. In this and in the method previously described, the porcelain facings may be soldered and the lingual cusp formed in one investment.

The method of construction of molar crowns with porcelain facing is similar to that of bicuspid (Fig. 324).

Inlaying Porcelain Facings in Gold Crowns.—In this method the porcelain facing is inlaid or set after the construction of the gold crown.

The crown used may be either seamless or one constructed in sections, but the seamless crown is preferable.



FIG. 323.



FIG. 324.



FIG. 325.



FIG. 326.



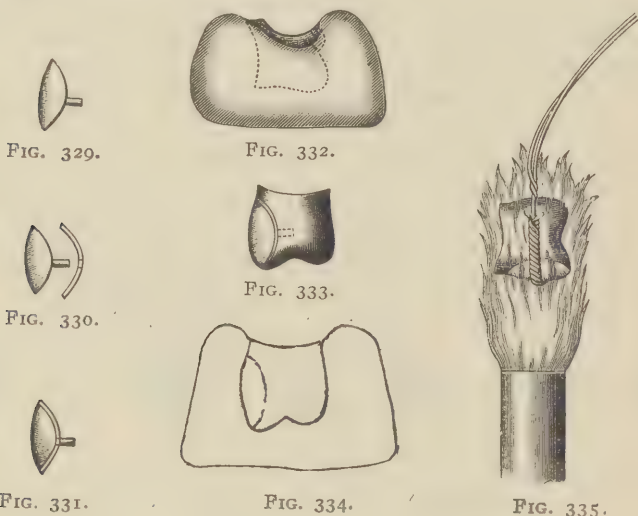
FIG. 327.



FIG. 328.

Application to a Seamless Gold Crown.—A seamless gold bicuspid crown will be used to explain the method. The crown is fitted to tooth or root and the occlusal surface reinforced, using Corona gold and solder—preferably hard solder—and boiled in acid to remove all flux. (See Fig. 377.) The crown is adjusted in the mouth and a mark made with a pointed instrument on the labial face of the gold to indicate where the porcelain facing is to appear (Fig. 325). The crown is removed and the marked piece of gold is cut out with a saw or a knife-edged wheel (Fig. 326), and the edge of the gold beveled to receive the facing when backed (Fig. 327). Grind the facing (Fig. 328) to accurately fit the space (Fig. 329). Next back the facing with pure gold, gage No. 36, extending the gold just over the edges, annealing and burnishing, or swaging, to secure accurate adaptation (Figs. 330 and 331). Trim backing to one-sixteenth of an inch of the edge of the porcelain. Adjust facing and backing in crown and attach the backing to the crown by flowing wax along the seam at the edge of the backing inside and outside the

crown. Next remove the porcelain facing, leaving the backing attached to the gold crown. Invest as shown in Fig. 332, paint exposed surface of the backing with rouge, and solder the edges of the backing to the gold crown, using as little solder as possible. Shorten the pins in the porcelain facing, insert it in position in the backing (Fig. 333) and slit the ends of the pins. Invest, as indicated in section in Fig. 334, and unite pins to backing by doing the soldering on the inside of the crown. A very small quantity of 14-carat or very easy-flowing solder filings should be used, the investment well heated and solder fused with a small pointed flame.



This last described soldering may also be done by wrapping the crown in asbestos paper, winding around it a wire and suspending in a Bunsen flame (Fig. 335).

In finishing, remove surplus edge of backing around the porcelain, burnish, trim and polish.

Inlaying Porcelain Facing in Sectional Crown.—The occlusal surface of the gold crown should be made of gage No. 36 to 38 pure gold, reinforced with coin gold and united to the collar by sweating or with hard-flowing solder. The constructive details of the inlaying of the porcelain facing are similar to the method already described except that the pins of the facing are preferably first soldered to the backing. The facing and backing are inserted in position in the crown, the edge of the backing attached all around with wax, both inside and outside of the crown, and the crown invested. The soldering of the seam around the facing

is more safely done by investing so as to expose and solder only one-half of the seam first, then reinvest and do the other half.

A Faulty Method of forming bicuspid crowns, especially in a close occlusion, and therefore one to avoid, is the shaping of the lingual side, as shown at W, in Fig. 336. The occlusal surface should be shaped so that the cusp of the occluding tooth shall be interlocked in occlusion, as illustrated at R, instead of glancing off. In the latter event, the root is liable in time to be forced outward and loosened.

Crowning in Cases of Abrasion.—In a case of extensive abrasion of the incisal edges of the anterior teeth with vital pulp considerably calcified in the coronal section, crown-work to restore the length and form of the teeth is best performed by removing a portion of the labial aspect in the preparatory operation of trimming the natural crown (Fig. 337), and forming the artificial crown similar to a gold collar crown with a porcelain facing without a post. Fig. 338 gives the outline of the

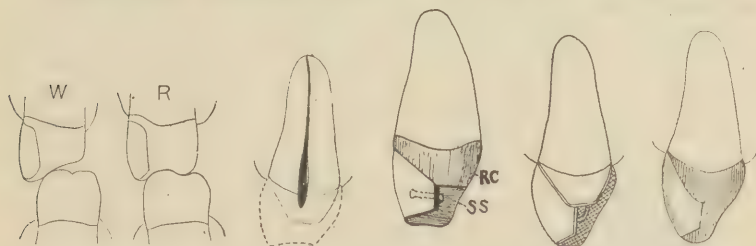


FIG. 336.

FIG. 337.

FIG. 338.

FIG. 339.

FIG. 340.

FIG. 338.—RC, root cap; SS, soldered section.

construction of such a crown. If a case having the natural crown worn down very short should suggest the necessity of a post, a short one can be inserted between the line of the pulp-chamber and the lingual wall. In case the tooth is pulpless, the canal can be opened and the post extended into the root.

The incisal edge of the porcelain should be well protected by the use of clasp gold and solder instead of the ordinary gold plate. When an incisal surface of considerable thickness is suggested, it is best built to the desired length after the first protecting piece has been soldered, by applying successive layers of plate rolled thin, of the size of the incisal edge, each being perforated with two or three holes with punch forceps, so that the solder shall more easily flow between and unite them. (See article on "Gold Tips," Fig. 445.)

Gold Crowns with Porcelain Facings for Teeth with Vital Pulp.

In the anterior teeth, in a case of atrophy, erosion or where decay has destroyed the approximal sides of a tooth in such manner that crowning

is considered desirable, the pulp is frequently found unexposed and in a normal condition. Its preservation in such a case is desirable.

The crowning of such teeth with gold jacket-crowns, carrying a porcelain facing attached with solder is generally a questionable procedure, unless considerable calcification of the pulp exists, as the room required for the gold and the small space left for the porcelain, together with the difficulty of securely attaching the latter, renders such a construction impracticable. Jacket-crowns for such cases are best made of porcelain. (See Part VI, Chapter VIII.)

When calcification of the pulp has progressed so as to permit construction of a crown with gold and porcelain, the natural crown should be reduced as much as possible, especially on the labial side. It is then capped, as outlined in section Fig. 339, and a porcelain facing ground, fitted and adjusted on the gold cap. The facing is then soldered to the cap and the cap reinforced, as seen in Fig. 340.

CHAPTER X

THE GOLD SEAMLESS CAP-CROWN SYSTEM

This method consists in the use of a gold seamless cap for the construction of the required root-cap or crown. Through improved methods seamless root-caps and crowns can be used by those versed in the method, to largely answer the purposes of caps constructed in sections.

Seamless Root-Cap for Incisor, Cuspid and Bicuspid Crowns with Porcelain Facing.—The advantage of this style of cap is simplicity, as the formation of a collar is avoided.



FIG. 341.



FIG. 342.



FIG. 343.

For a seamless root-cap the natural crown is ground down to within one-eighth of an inch of the gum at the lingual wall, or enough to fully clear the antagonizing teeth when occluded, and slanting from the lingual side of the pulp-chamber to or slightly under the cervico-labial edge of the gum. The periphery is shaped the same as for a collar crown.

For a partial seamless root-cap, which avoids extension of the collar around the cervico-labial section (Fig. 341), that side of the root is left intact, as shown at A, Fig. 342.

Impressions and Dies.—A die of the end of the root is first made. For this purpose an impression is taken in a tube about an inch long formed of a strip of copper, or in a ready-made tube such as are sold for the purpose. The tube must be the size of the end of the root. It should be first cut and shaped to the curve of the gingiva so that the

edge fits uniformly well under the free margin, especially at the lingual side (Fig. 343). The impression is best taken with impression compound. It should be heated, the tube entirely filled with the compound and the end to take the impression again heated sufficiently to render that part of the compound very soft just before being applied to the root.

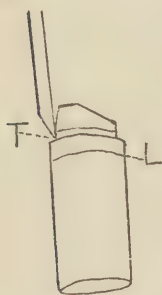


FIG. 344.

The tube is then adjusted and pressed to position on the root, held firmly, and the extra compound which has been forced out of the other end of the tube pressed on by the finger and so held with the tube in position, until the compound cools. The cooling may be hastened by applying a stream of cold water with a syringe.

When the tube is removed the impression of the root end will be found proportionately as perfect as an impression procured for the formation of an inlay by the indirect method. Form the die of amalgam and the result will be as near an approach to absolute accuracy in detail as it is possible to procure. The amalgam must be thoroughly mixed and carefully packed, as described at page 29, and allowed to set until the next day. Plaster may be used instead of impression compound to take the impression in the tube and the die cast immediately of fusible metal, but it will lack the accuracy in detail obtained by the previous method with amalgam. The die when removed from the impression should be lengthened by removing from the cervix about one-eighth of an inch of the shoulder of metal formed by the edge of the impression tube (shown at T, Fig. 344), to the dotted line marked L. The lengthening should be accomplished without altering or marring the die in the slightest degree. The trimming is preferably done with a chisel resting against the side of the die, pointed in a downward direction toward the shank, then smoothed with a file. A fissure bur also assists in removing surplus metal. The bur should be positioned at a right angle to the shank and revolved so that it will be thrown downward on the shank instead of upward on the die. The die is next mounted in a swager cup, as outlined in Fig. 345, and described in Part I, Chapter V. As the fine lines of an amalgam die would be impaired by the preliminary shaping of the cap, a duplicate in fusible metal should be made and first used to shape the cap and then the amalgam die to give it the finish. To do this quickly and easily, press the mounted

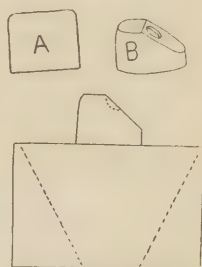


FIG. 345.

amalgam die down into the surface of a flat piece of moldine, remove and place the cup of the swager over the mold and fill the cup with fusible metal through the hole.

Method of Stamping Seamless Metal Caps.—The gold plate generally used for seamless caps is 22 carats, or platinized gold 23 carats, termed non-oxidizable gold, gage No. 29 to 30. The gold plate is first cut in a circular piece by a disk cutter. It is next pressed through a steel die-plate with punches gaged to the holes. Each time the disk is punched only a small portion of the gold is turned over, thus

preventing it from lapping or creasing. A properly constructed press should be used for the purpose, such as is illustrated in Fig. 346.

The cap (A, Fig. 345) is annealed and swaged on the die to the typical form B. The palatal portion of the cap should be allowed to go well under the free margin of the gum. In the process of adjustment,

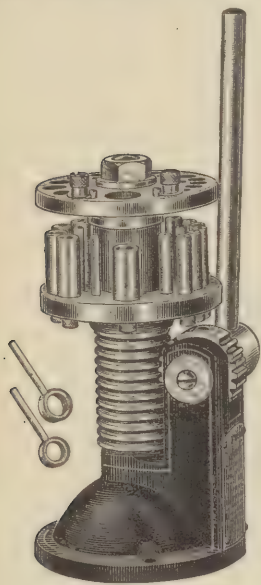


FIG. 346.



FIG. 347.



FIG. 348.



FIG. 349.

edges that fit under the gum should be marked and trimmed as directed in describing the construction of a collar crown and then burnished close to the sides of the root and into the orifice of the root-canal, forming a perfect-fitting seamless cap (Fig. 347). In cases of partial caps, to better define their position on the root end, all the gold at and over the cervico-labial edge should be not removed until the post has been soldered. An iridio-platinum post is next fitted in the root-canal and soldered to the cap (Fig. 348) as in the construction of the gold collar crown with porcelain facing (see Figs. 284 and 285), with which operation the remainder of the process of construction is identical. Fig. 349 represents the completed crown in section.

All-gold Seamless Bicuspid and Molars.—All-gold seamless crowns for bicuspid and molars that will accurately fit the natural

crown and root and occlude properly with the antagonizing teeth are formed as follows: The natural crown is properly prepared. If decayed or broken down on the side, it should be shaped up with amalgam (see Figs. 168, 170, 178 and 180). A copper tube—seamless or soldered—is accurately fitted to the prepared tooth. At the cervix it is placed the same distance under the gum margin as for a gold crown. An impression is then taken in compound and an amalgam die made (see Figs. 21, 23 and 24). Lengthen the neck and taper the shank of the die. Take a wax “bite” and then an impression in wax or compound. If you intend to remove the die from the model veneer the shank with wax. Insert the die in the imprint of the tooth in the impression and run a plaster model. On removal of the impression the die will be found in position in the model an exact replica of the tooth in the mouth (Fig. 350). The wax “bite” is then adjusted and an articulating model made. Drill one or more holes in the occlusal surface of the die and do any necessary shaping or contouring of the form of the

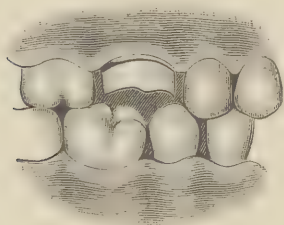


FIG. 350.

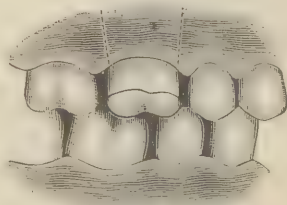


FIG. 351.

tooth with hard wax or, better still, oxyphosphate. A space should be left between the antagonizing teeth and the occluding surface, and between the approximal teeth the thickness of the gage of gold to be used (Fig. 351).

An impression is taken of the amalgam die in a tube with moldine and a fusible metal die run. The die on which a gold cap is swaged should always be lengthened at the neck so that the crown when constructed will have a surplus in depth of gold to allow for any trimming of the collar that may be required (A, Fig. 352). A swager is used as a counter-die or a counter-die (B) can be made by punching a hole in a block of lead and hammering the die into it. (See page 28.) The cap (A, Fig. 353), gage No. 29 to 30, is placed in the die, tapped with horn hammer to the general shape, and with the aid of the swager or counter-die swaged to the form of the crown (B). When a lead counter-die is used an allowance for the thickness of the gold should be first made by driving the die with two thicknesses of kid into the

counter-die to enlarge it. If this space is not made the gold is liable to be torn in the swaging. A piece of kid leather or rubber-dam should be used to cover and protect the gold cap in the swaging and facilitate its removal from the counter-die.

The amalgam die is next divested of the wax or oxyphosphate contouring material which was added to its surface, and it is restored to the original form of the tooth in the mouth. The gold crown is then adjusted, trimmed to the curve of the gingiva at the cervix and burnished, and it is ready for adjustment in the mouth.

The method described is the most approved. Another method is to fit a copper collar to the periphery of the root, take a "bite," then

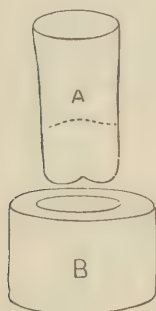


FIG. 352.



FIG. 353.



FIG. 354.

an impression that will remove the collar in position, and run plaster models. When the models are made, slit and remove the copper collar. This gives a plaster form of the tooth, which is built up and shaped to the required form of the crown and the crown then made by it, as in the preceding method.

All-gold Seamless Incisors and Cuspids.—Incisor and cuspid crowns from which a portion of the gold on the labial aspect is to be removed (see Open-faced Crowns, Fig. 590), or which are to be used entire as supports for bridge-work can usually be advantageously formed with seamless caps (Fig. 354). The cervixes of these crowns often have to be contracted in fitting by slitting, lapping and soldering.

CHAPTER XI

IMPARTING CONTOUR TO SEAMLESS GOLD CROWNS

Crowns Swaged on Dies

Method of Slitting and Contracting the Neck.—Crowns for cases in which decay has extensively involved the approximal sides, owing to encroachment of the adjoining teeth, generally require very little if any contouring. It should be borne in mind that a swaged seamless crown on the approximal surfaces is always the thickness of the gage of the gold cap larger in circumference. Some form can be imparted to a swaged straight-sided seamless crown by slitting the collar directly in



FIG. 355.

the center of the lingual side, contracting the neck, tapering the underlapping portion, adjusting on the tooth, burnishing the gold, removing and soldering (Fig. 355). This contraction also imparts a very close fit to the neck. When more contour is required than that obtained by the thickness of the gold plate

that covers the die, the crown may be formed with the desired size and shape of occlusal surface and then slit and contracted at each of the approximal sides, fitted and soldered.

Use of Contouring Pliers.—Contouring pliers are used to give form to a seamless crown sufficient to knuckle it against the adjoining teeth, but the bulge that is imparted by this means is not located close enough to the occlusal surface, where it is most required.

External Application of Contour.—Contour may be added to a seamless gold crown by soldering so as to knuckle in a very accurate form to an adjoining tooth or teeth as follows: When the gold crown has been fitted and articulated heat the crown and veneer the approximal surfaces with wax cement. Soften two pellets of adhesive wax and press and shape them against the sides of the gold crown. Adjust the crown on the tooth and press both crown and wax to position and occlude teeth. Remove and trim wax to exact form of desired contour. Place over the surface of the wax representing the approximal surfaces a layer of platinum foil $\frac{1}{2000}$, as marked PF, Fig. 356. Reinsert crown in mouth, occlude teeth and remove. Invest crown, leaving occlusal

surface of wax exposed as shown in Fig. 357. Remove the wax with boiling water. Pack pellets of Corona gold between the crown and platinum foil to prevent the foil being drawn from position in soldering. Heat and flow solder, or coin gold if cap is made of platinized gold, into the space occupied by the Corona gold, between the crown and the platinum foil, trim and polish. This method gives a close, accurate knuckling for a seamless crown or any form of constructed crown to which it is applied. Coin gold or hard solder should be used to contour when the crown is to support bridge-work, so as to maintain the form of contour in subsequent soldering. In the case of a single crown, 20-carat solder is suitable.

To Contour on a Die with a Swager.—A seamless crown may be given a moderate amount of contour on the swaging die in the following manner: Form a model of the crown with the addition of the required

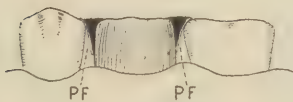


FIG. 356.

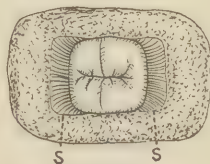


FIG. 357.—SS, spaces to be filled.

contour, take a plaster sectional impression formed longitudinally in halves (See Fig. 15), and cast a die of fusible metal that melts below the boiling point of water. Place over the die a tight-fitting seamless gold cap, swage the occlusal surface if a bicuspid or molar, then mallet and burnish the gold lengthwise as closely as possible to the die. Next mount the die in a swager by inserting the base in impression compound (Fig. 358). Swage the gold cap to the sides, using moldine or fine shot in the swager. When the swaging is completed, remove the die from the crown by placing it in boiling water to melt out the fusible metal. Should any of the metal adhere to the gold, remove it by placing the crown in nitric acid.

Sectional Mold Method.—The artistic requirement of all-gold crown-work is that it shall reproduce the anatomical contour of the natural teeth. Such a form can be given seamless gold bicuspid and molar crowns by the sectional mold method (Figs. 359, 360 and 361).¹

Formation.—To describe and illustrate the process, fit a collar of copper, No. 30 gage, knuckle it against the approximal teeth and trim the edge to clear the antagonizing teeth in occlusion. Place cement

¹ This method was originally introduced by the author in 1888.

or plaster in the occlusal end of the collar only and occlude the teeth. When set, remove, trim and shape to the desired form for gold crown.

Shaping the Cap.—Flasks are now manufactured and sold to facilitate the formation of a metallic sectional mold. Fig. 362 illustrates a flask of this kind, termed a dividing mold cup. Place the model—neck downward and cusps up—in the center of a cake of moldine (Fig. 363). Set the dividing cup over it—small hole up—with the ribs of the cup opposite either the long or short axis (diameter) of

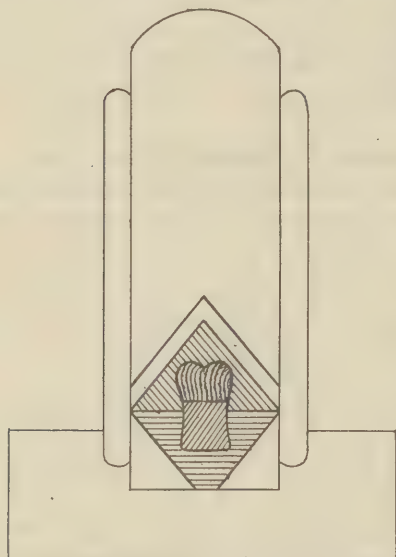


FIG. 358.



FIG. 359.



FIG. 360.

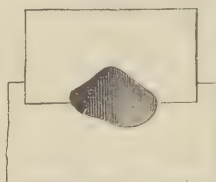
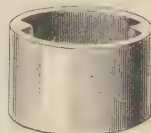


FIG. 361.

FIG. 362.—
Dividing mold
ring, $\frac{3}{4}$ size.

the crown. Melt fusible metal and pour through the small orifice of the ring, completely filling it. Melt off surplus metal with a hot wax spatula or cut it off with a strong plaster knife. Now set ring and mold in the knock-out block (Fig. 364), and with a light tap on the punch (Fig. 365) placed on the metal exposed at the small orifice of the ring, remove mold from ring.

While the mold is still warm open the handles of the splitter (Fig. 365) sufficiently to insert the blades in the grooves formed by the ribs of the mold cup, and with a gentle steady pressure split the mold through the center and remove the crown model. The two halves of the mold will go together perfectly, forming a matrix for the reception of the gold cap or shell. Form or select a gold cap, comparing the wire root measurement for size; anneal the cap, carefully vaselin the surface and place it in the two halves of the split mold. Place the split mold with cap back into the mold cup and with a soft pine wood stick press in the cap sufficiently to seat it in the mold and by hammering on

the end of the stick partially form the cusps. Remove the pine stick and fill the shell with soft unvulcanized rubber, place ring with mold and shell in the base of the swager, the cylinder of which is partly filled with moldine covered with a disk or rubber-dam, and swage down two or three times. To facilitate the process, remove the cap, then the rubber from the inside, anneal and re-swage until the cap assumes the form of the mold. When swaged, boil the crown in acid, trim and polish. Fig. 366 shows the finished crown. This method gives a crown of the exact size desired, accurate in articulation and in fit at the cervical margin.

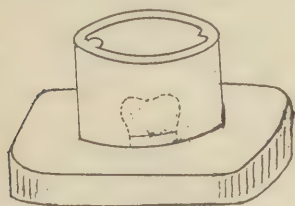


FIG. 363.

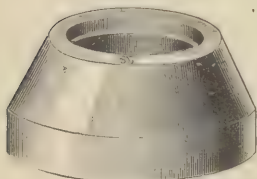
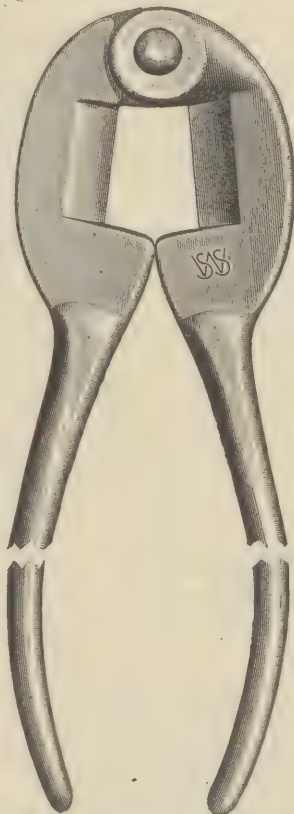
FIG. 364.—Knock-out block,
 $\frac{3}{4}$ size.FIG. 365.—Mold splitter, $\frac{3}{4}$ size; punch,
 $\frac{3}{4}$ size.

FIG. 366.



Another method to form a mold that will avoid bubbling of the fusible metal in pouring is as follows: Hold the plaster tooth—occlusal side down—mounted on a sprue wire with pliers, supported so that it will be suspended down in the center of the dividing mold ring, with the cervical margin below the edge of the ring. Heat fusible metal and pour into the ring around the plaster tooth. When set, remove cup, split mold while hot and remove plaster model, as in the preceding method.

CHAPTER XII

ADJUSTMENT OF SEAMLESS GOLD CROWNS

The description given will relate to specially formed seamless gold crowns, those made by dies or in molds, and to ready-made seamless gold contour crowns. A

superior molar will serve as a typical case to illustrate the process of adjustment. The crown or root is one that has been shaped and is straight or tapering slightly on its sides toward the occlusal surface. A crown of the proper size is specially made, or selected from ready-made stock. If the latter, its selection will be facilitated by having a plaster model of the case and a wire measurement of the cervix.

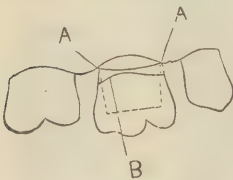


FIG. 367.



FIG. 368.

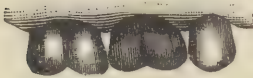


FIG. 369.



FIG. 370.

The crown is annealed, slipped over the end of the root or tooth and gently worked upward; the gold of the collar will partly adapt itself to the form of the root in the operation until the edge meets the margin of the gum (AA, Fig. 367).

1. Mark a line (B) on the gold parallel with the margin of the gum.
2. Remove and trim to this line (AA, Fig. 368). If necessary repeat the marking and trimming until the edge meets the gum evenly.
3. Bevel the edge of the gold, readjust the crown and press it up until the edge of the collar passes under the margin of the gum and, if the occlusion is correct, burnish the gold to the cervix (Fig. 369).

Expansion of the Collar and Crown.—If the collar for the crown needs a slight enlargement, it is easily and most properly accomplished with crown expanders (shown in miniature in Fig. 370), the points of which should be introduced at first just within the edge of the neck, and the gold spread sufficiently to allow it to fit over the end of the natural crown or root or its model, the process of expansion being gradually

continued as the crown is brought into position. By proceeding in this manner too great expansion is avoided.

Alteration of a Side or Part of a Crown.—The contour of one or both sides can be depressed and the crown thus narrowed by intro-

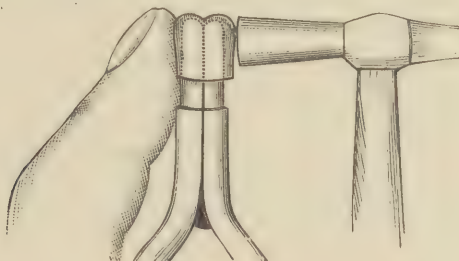


FIG. 371.

ducing the points of a crown expander, or some tool that will fit loosely inside the crown, then steadying the crown with the fingers, as shown in Fig. 371, and tapping the side to be reduced with the flat end of a riveting hammer. Pliers will also accomplish it,



FIG. 372.



FIG. 373.

one beak being placed inside the crown and the other against the bulge on the outside (Fig. 372). This is necessary when the side of the crown presses on an adjoining tooth and the crown is thus prevented from coming into proper position.

Alteration of the Occlusal Surface.—Before the crown is pressed up to its apparently proper position, the occlusion should be examined and calculations carefully made to obviate any defects of articulation,

which may be corrected at this stage by proper manipulation of the crown. Place the crown in position on the tooth and flatten the interfering part with a large gold foil condenser, tapped with a mallet, or hold the crown and tap the part, as shown in Fig. 373. The closing of the antagonizing teeth with force upon the crown by the patient, will aid or complete the operation of articulating.

To Deepen the Cusps.—Trim a piece of wood to the form shown in Fig. 374, rest the neck of the crown on a folded napkin and press the wood between the cusps.

To Point, Lengthen or Narrow the Buccal Cusp in Appearance.—To so change the buccal cusp of an upper bicuspid crown, gently tap the gold on each side of the cusp toward the point at the angle shown in Fig. 375.



FIG. 374.



FIG. 375.



FIG. 376.

To lessen or remove indentations between cusps, and flatten the entire occlusal-surface, introduce inside the crown a flat-ended piece of wood the size of the crown and press downward, as shown in Fig. 376.

Strengthening and Reinforcement of Seamless Gold Crowns.

Additional strength and stiffness may be given to seamless gold crowns when desired in several ways, by soldering in an open flame. The liability of melting the gold which forms the side of the crown in the operation is the objection to the method. The crown should be held in the upper section of the flame, watched and instantly removed as soon as the solder fuses and flows. The heat should be very gradually and uniformly applied by turning and moving the crown well up and down in the flame so that the gold of the crown shall not become hotter than the solder. If this precaution is not observed, the solder when it melts is liable to penetrate the gold of the crown. The crown should be held in such a position that a full view of the interior is presented and the melting of the solder rendered visible, which will occur at a *red heat*.

To Stiffen the Entire Interior of the Crown.—After it has been properly adjusted, dampen the inner surface with wet cotton on the point of an instrument, place in the interior a quantity of dry fluxed solder filings,

place the finger over the neck of the crown, invert and shake well. A portion of the solder filings will adhere evenly all over the wet surface. The finger is then removed and the surplus dropped back into the bottle. Catch the edge of the neck with tweezers and heat the crown in a large Bunsen flame until the solder fuses, when it will flow evenly over the surface of the gold without materially altering the general form.

The occlusal surface of seamless crowns can be thickened by filling the interior of the cusps with solder. If considerable of the natural crown is present, the solder should be confined to the cusps, avoiding all excess, which would be liable to obstruct the readjustment of the crown, a difficulty which often occurs and is troublesome to correct.

Method of Forming a Solid Occlusal Surface.—An occlusal surface of solid gold which will be uniform in shape with that of the natural crown it is to cap, and not liable to interfere with the readjustment, may be formed as follows: Dry the gold crown and place in the interior of the grinding-surface a layer of Corona gold. Insert the crown, press to position and occlude the teeth and remove the crown.

The Corona gold will exhibit an impression of the tooth. Add more to it until a nearly condensed lining of it fills the occlusal surface. Now, slightly depress this lining with an oval-shaped condenser to gain space, and saturate it with solder. This is done by applying and fusing

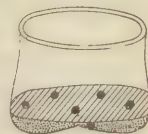


FIG. 377.

the solder cut in very small pieces, or fluxed solder filings, on the surface of the gold, a very little at a time and in quantity only as much as the Corona gold will absorb. If more is applied the adjustment of the crown is liable to be obstructed. If the operation is properly performed, it will result in an interior of gold that will correspond in form with that of the natural tooth. Another method is to cut a disk of $\frac{1}{1000}$ platinum foil the size of the interior of the occlusal surface. Punch four or five holes in the foil with a punch forceps and place the disk in position in the interior of the cap over the Corona gold. Adjust the crown and occlude the teeth; remove, place solder in small pieces with flux on the disk and heat crown. The solder will flow through the holes and *confine itself entirely to the other or inner side of the disk* (Fig. 377).

External Reinforcement with Platinum and Gold in "Close" Bites.—In a very close "bite," when the removal of only very little of the occluding surface of the tooth crowned, or of the occluding teeth, is permissible, one or more layers of perforated heavy platinum foil of a size sufficient to cover only the occluding surface may be pressed or swaged to its form and closely soldered, using only a very small quantity of hard solder. By this latter method the occluding surface

will occupy the least possible space and present a metallic face that will effectively resist attrition for some time. The platinum will absorb enough of the solder, if sufficient heat is applied, to give the grinding surface of the crown a color resembling that of clasp gold. This method can be applied to the occluding lingual surface of anterior crowns as well as to occluding surfaces of the posterior teeth.

Solid Seamless Gold Pontics.—Gold seamless crowns, especially those made of platinized gold, may be filled solid for use as pontics in bridge-work by investing the outside surface in investment material, heating the investment, placing small pieces of hard solder—one at a time—inside the crown and fusing by applying the full flame of the blow-pipe mostly around or underneath the investment.

Altering a Seamless Gold Crown to the Form of a Corresponding Natural Crown.—Ready-made gold seamless contour crowns frequently afford the means of easily and quickly performing a crown operation, especially in temporary bridge construction. In a case where nearly all the natural tooth is present but the occlusal surface and the sides differ in shape from the form of the gold crown to such an extent as to interfere with its adjustment, a die of the natural crown is made of fusible metal and with the die the interior of the gold crown is altered in shape sufficiently to receive the natural crown. This generally can be easily done by resting the occluding surface of the gold crown on a folded napkin and gently tapping the die into it. By this means a ready-made gold crown may be quickly altered to a required form.

Comparative Merits of the Seamless and Sectional Methods of Gold Crown Construction.—The seamless and sectional crown methods each possess their respective advantages for the accomplishment of the work in hand. By expertness the same effective result may be accomplished with few exceptions by either method. The constructive details of each adapt it specially to certain classes of work. That method should be applied therefore which, according to the circumstances, affords facilities for the accomplishment of the result with the least labor. Thus, crowns for very short teeth of abnormal occlusion; also cases of abrasion requiring special forms of incisal and occlusal surfaces of solid metal are preferably constructed in sections. Bicuspids and molars, as well as incisors and cuspids, when all or nearly all of the natural tooth is present and the occlusion is normal, may frequently be constructed to advantage by the seamless methods. In the construction of temporary bridge-work for use during the formation of the permanent piece, seamless crowns may be utilized to advantage, as they may be easily and quickly applied.

CHAPTER XIII

CAST GOLD ROOT-CAPS AND CROWNS

Either root-caps or whole or partial crowns are made by the cast method.

Cast Root-cap.—For cast root-caps the end of the root is prepared with a slight bevel, as shown in Fig. 378, so that in the finished root-cap the cervical edge will present the least perceptible line of union with the root possible. The wax model of the cap is best obtained by the indirect method from an amalgam model of the root end. The sprue wire is inserted as shown in Fig. 379. The root-cap should be cast of a gold alloy possessing rigidity and strength. (See formula page 8.)

Cast Gold Crown with Platinum Collar.—This consists in the construction of a cast gold crown with a thin platinum collar forming the cervical edge. This thin platinum permits of being closely adapted to the root under the gum margin, leaves an almost imperceptible edge, and the platinum surface is more benign to the tissues than gold.



FIG. 378.



FIG. 379.



FIG. 380.

Form a collar of platinum, gage No. 38 to 40, such as is outlined in Fig. 380, that fits the cervical line tightly. Fuse a film of pure gold over the outer surface of the platinum fully as far towards the cervical edge as you desire the gold to extend. Coat the inner and outer surface of the collar of the crown with wax, adjust on the tooth, remove and trim. Trim the occlusal edge of the wax to the edge of the collar and add a thick floor of wax to form the cusp-cap. Adjust in the mouth, occlude teeth and remove. Trim and shape the wax to the

required contour for the crown, make final adjustment to determine accuracy, and remove. With a slightly heated spatula and largespoon-shaped excavator scrape off entirely the layer of wax on the cavo or inner surface of the platinum collar. Insert the sprue wire at an angle, as shown in Fig. 381, invest and cast.

The removal of the wax from the inside of the collar leaves a space between it and the sides of the tooth except at the cervical edge. This space avoids interference from contraction of the cast gold and gives a slight space for the presence of cement.

Cast Gold Crown on a Sectional Platinum or a Seamless Gold Cap. This method is generally applied only to bicuspid and molars. An inferior molar will be taken to illustrate the method. A platinum tooth-cap of gage No. 36 to 38 is made by the sectional method, with the seams soldered with 10 per cent. platinum solder (Fig. 382). The cap should closely fit the cervix of the tooth but leave a space at least one-sixteenth of an inch between the floor and the antagonizing teeth. A seamless cap of either platinum or gold may be used instead of the platinum cap constructed in sections.

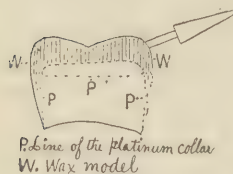


FIG. 381.



FIG. 382.



FIG. 383.

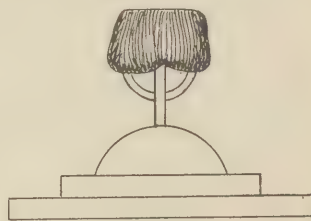


FIG. 384.

The gold crown section is made by shaping up the platinum tooth cap with inlay wax to the desired form and casting it. For this purpose inlay wax is placed on the tooth-cap, the cap adjusted and pressed to position on the tooth and the teeth occluded. The tooth-cap and wax are removed, the wax trimmed and the occlusal surface shaped and carved in detail (Fig. 383). The wax crown section is then chilled and removed from the tooth-cap, mounted for casting, as shown in Fig. 384, invested and cast of pure or 22-carat gold. The cast gold crown section is fitted on the tooth-cap and the cavo-surface of the cap is filled with investing material and the cap and crown sections clamped. The two sections are then united by fusing small pieces of 20-carat solder around the edge of the crown section as indicated at SS, Fig. 383, then drawing the solder between the sections by occasionally pointing the flame upon the occlusal surface.

Another method of construction is to use a seamless platinum cap of gage No. 36, or one formed in sections soldered with platinum solder containing 15 per cent. of platinum, and then casting the gold crown-cap directly on the tooth-cap. The contraction of the gold when cast being liable to affect the fit of the crown on the tooth, is the objection to this method.

An amalgam die set in a plaster model of the case is generally used in making gold crowns by either of these methods.

CHAPTER XIV

VARIOUS FORMS OF PORCELAIN-FACED GOLD CROWNS

Several methods of capping the end of the root are practiced intended to afford protection against decay and fracture without the use of a collar.

The Beveled Edge Cap.—Grind the end of the root flat, then taper off the lingual and approximal sides and grind the labial section in a slanting plane from the flat surface of the end of the root to and under the cervico-labial margin of the gum, as shown in Fig. 385. The cap is made of platinum No. 36 gage stamped on a die of the form of the root end.¹



FIG. 385.

For these forms of root caps, the orifice to the canal should be deeply countersunk to securely attach the post.

Partial Collar Crowns.—The advantage of a collar can in a measure be given post-crowns by the addition of a partial collar or metal flange encircling the lingual half of the end of the root. For this purpose the end of the root should be trimmed, as shown in Fig. 386, and the lingual section shaped as seen at A.²

To form a partial collar-cap for the root, make a collar to entirely encircle the prepared root. Trim the collar level with the root end and adapt a floor of gold or thin platinum.



FIG. 386.

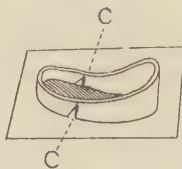


FIG. 387.



FIG. 388.

To confine the attachment of the collar with the solder to only the required lingual and approximal sections of the floor, the formation of the two V-shaped notches seen at the points C, C, Fig. 387, will cut

¹ Form used by the author.

² Dr. T. F. Chupein's method.

off its further extension. The labial section of the collar, being unattached to the floor, is then easily removed, leaving the floor intact; this though should not be done until the post has been fitted and soldered.

The method of constructing a partial cap-crown described, is similar to that for making the outer cap to the double cap-crown of removable bridge-work, where a collar that entirely encircles the root is first made and the labial section removed.

The Litch Crown.¹—This serviceable partial collar crown is made as follows: The end of the root is shaped the same as shown in Fig. 386, and the orifice to the canal well countersunk. A post is fitted to the root-canal, an impression taken of the end of the root with the post in position, the post varnished and an amalgam die made. The post is removed, a disk of platinum, gage No. 36, is cut in oval form and shaped to the die by slitting the portion on the sides that is to form the collar, then burnishing the slit portion to the die, mounting the die in a swager and swaging the cap (Fig. 388 in section). The cap is trimmed, invested, and the slits soldered with pure gold, using only enough to unite them. The cap is then re-swaged to remedy any contraction caused by soldering.



FIG. 389.

In the use of partial cap crowns, after the post is fitted and soldered in position in the cap, the edge of the cervico-labial section of the floor of the cap may be removed and the base of the porcelain facing ground to rest directly on the root. Fig. 389, in section, outlines a Litch crown ready for investment.

In these styles of crowns the main part of the work may be done by the indirect method on models, but a final adjustment of the cap and porcelain facing in the mouth is advisable.

¹ Dr. W. F. Litch.

CHAPTER XV

PORCELAIN DETACHED-POST COLLAR CROWNS

S. S. White, Dentsply, Ash and Justi Crowns.—Prepare and shape the root and fit a collar. Grind down the collar even with the end of the root and well under the gingiva at the cervico-labial margin, if for esthetic reasons it is desired to hide the collar at that point. Fit and adjust the post (Fig. 390); select a suitable detached-post crown and grind crown to fit the end of the root and the edge of the collar. The crown and post are removed and a disk of pure gold plate, gage No. 32, or preferably platinum, gage No. 40, is fitted to the collar as a floor with a slight surplus extending over the edge. The base of the porcelain crown is pressed against the floor to hold the gold or platinum in position on the root and the surplus edge of the floor bent and burnished tight against the edge of the collar. The collar and floor are next removed, placed together as defined by the burnishing, and united by the least possible quantity of 20-carat solder. The surplus edge of metal around the collar is trimmed evenly, the cap adjusted to position on the root, the floor perforated and the post inserted and attached with wax.



FIG. 390.

The crown is next adjusted on the cap to define the proper position for the post in the crown as well as in the root. Should the post interfere with proper adjustment of the crown, the hole in the porcelain must be reamed or the post slightly trimmed, or both until the crown assumes proper position. The cap and post are then cemented with wax, removed, invested and soldered. The cap is adjusted on the root and the crown accurately fitted to the floor. This is assisted by pressing the ground base of the porcelain against the floor of the cap to indicate where to trim the porcelain. Repeat until the entire base meets the metallic surface evenly. If the thickness of the floor at the cervico-labial margin causes the joint of the porcelain to show, thin the surface of the floor at that point. For this reason a $\frac{1}{1000}$ platinum foil floor, which can be reinforced with solder at the lingual section when the post is connected, should be used if an invisible joint of the porcelain is demanded.

Adjust the cap and post on the root and only cement crown in position on the cap. When the cement has set sufficiently, remove cap and crown. Trim any cervical overhanging edge of porcelain at the sides even with the collar, polish and cement the finished crown on the root. Fig. 391 shows porcelain crown ready to be cemented on capped root and Fig. 392 the crown cemented.

Attachment of Porcelain Crown with a Metallic Base Backing.

This consists in swaging or casting a cup-shaped backing or base to a porcelain crown and soldering it to the floor of the root-cap. The base of the crown is ground so as to leave a V-shaped space at the lingual side. For a single incisor or cuspid crown, the backing is extended slightly upon the approximal and lingual sides, as shown in



FIG. 391. FIG. 392.

FIG. 393.

FIG. 394.

FIG. 395.

Fig. 393. For a bicuspid or molar, the backing is brought over the sides so that it will form a cup-shaped socket in which the crown will sit and thus greatly lessen the chances of its fracture in use (Fig. 394). To make an allowance for the extension of the gold backing on the sides of the crown, the porcelain must be proportionately removed, as shown in Fig. 395, so that the porcelain and gold when trimmed and polished shall present a uniform surface. When incisors and cuspids of this style are to be used as a bridge abutment, the side or sides approximal to the bridge should be grooved additionally, as shown in Fig. 396, to make room for a substantial extension of the gold in the form of a flange, to afford an attachment for the bridge.

To form the metallic backing, mount the crown—base up—in a swager, as shown in Fig. 397. Swage a backing of gold gage No. 35 or platinum gage No. 38 to the form of the base. Trim the backing to the proper size; puncture the plate over the hole in the base of the crown and insert a post; attach with wax, remove and solder. Mount and adjust the crown on the root-cap, as shown in Figs. 393 and 394; attach root-cap and backing with wax, remove crown, invest cap and

backing (Fig. 398) and fill the V-shaped space with solder and, reinforce the sides of the backing with a little of the solder. Fig. 399 shows a finished cuspid crown and Fig. 400 a bicuspid crown. In the construction, the backing can be cast, but swaging is the preferable method.

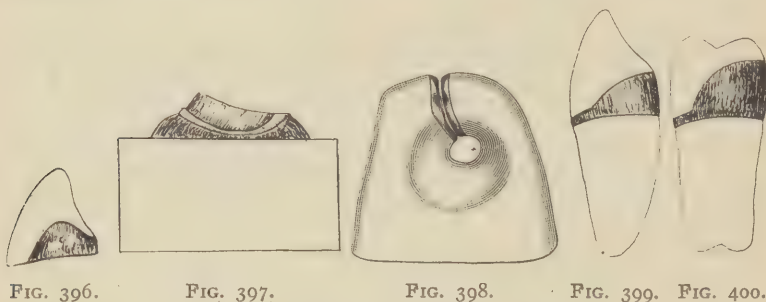


FIG. 396.

FIG. 397.

FIG. 398.

FIG. 399. FIG. 400.

In preparing porcelain crowns in any of these methods, sharp corners or edges should be rounded and polished to avoid chipping the porcelain or cutting through the gold in swaging.

Diatoric Porcelain Tooth Crown.—In this style the porcelain section of the crown is formed of a diatoric tooth. These teeth are applied only to bicuspid and molars. Their use is generally confined to lower teeth and bridge-work in cases where the sight of a gold occluding surface would be objectionable. Fig. 401 outlines the plan of their structure. Figs. 402 and 403 illustrate a backing adjusted to a diatoric tooth.

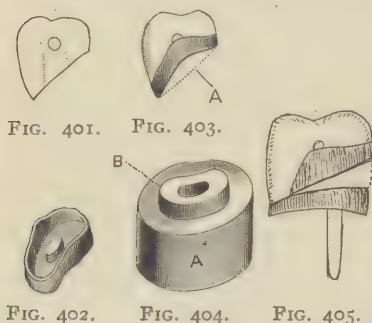


FIG. 401.

FIG. 403.

FIG. 402.

FIG. 404.

FIG. 405.

The tooth selected should fit with as little grinding as possible. When fitted, a piece of pure gold gage No. 32 is cut of a size to cover the base and fit over the edge about one-sixteenth of an inch. The gold is adapted to the surface and pressed into the depression in the center.

The porcelain tooth is next mounted in a swager (Fig. 404) and the gold swaged. If the gold is perforated in burnishing and swaging into the center hole B, fill the perforated depression with gold foil or Corona gold, trim the edges around the sides and burnish. Remove, invest and flow gold solder into the depression and Corona gold and a little over the adjoining surface. Tooth and socket are mounted with wax on the cap (Fig. 405) and pressed to position in accordance with the occlusion.

The excess of wax around the sides of the socket and cap is trimmed level with the surface of the gold. The surface of the wax on the sides is then covered with a strip of No. 60 rolled gold or $\frac{1}{2000}$ platinum foil, leaving the lingual side open to act as a matrix. The diatoric tooth is next lifted from the socket and the socket and cap are invested and soldered together. The diatoric tooth is cemented in the cap. In bridges the backings or bases are united and reinforced with solder to the line as indicated at A, Fig. 403.

Cast Base for Detached-Post Crowns.—When a cast gold base is used instead of a swaged base for any of the detached-post crowns described, the wax model of the base should fit the crown accurately but loosely. This slight looseness is to allow for contraction of the gold in casting.

Allowance for Contraction.—For all styles of cast backings or bases for porcelain crowns or pontics, a uniform allowance for contraction in casting is secured by giving the surface of the porcelain a uniform coat of collodion and when dry, vaselining its surface before forming the wax model. The subsequent removal of the collodion will furnish the required space.

CHAPTER XVI

PARTIAL CROWN-WORK

Restoration with Inlays

History.—The restoration of decayed teeth by mechanical means other than the use of various filling materials packed into the cavity dates back to the latter part of the last century. Dr. Herbst, of Germany, who was visiting this country about thirty years ago, brought to the attention of the profession his method of filling cervical cavities which were exposed to view, with cemented glass inlays colored to approximate the shade of the teeth so as to appear less noticeable than the filling materials then in use.



FIG. 407.



FIG. 406.

FIG. 408.

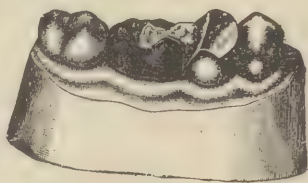


FIG. 409.

Dr. Herbst's operations drew attention to inlays as a method of artificial restoration of tooth structure. The possibilities which might be obtained by such a method were an incentive to the inventive genius of members of the profession, who have since gradually brought the method to the prominence it has now obtained in dental practice.

Coincident with the improvements made on Dr. Herbst's early inlay operations by the substitution of low- and high-fusing porcelain for anterior teeth, was the use of gold for the posterior teeth. These early operations with gold consisted in swaging or bending pieces of plate to the contour of the part of the tooth to be restored and then trimming the gold so that it accurately fitted the orifice of the cavity. A pin or pins were soldered to the cavo-surface of the plate to retain it

in position in the cement or gutta-percha with which the cavity was filled (Fig. 406). This style of restoration was followed by the box or hollow inlay. This consisted of a shell of thin gold plate shaped to the cavity like a matrix¹ with a hole in the center of the cavo-surface (Fig. 407), with plate to form the contour soldered over it and trimmed to fit the edge of the cavity (Fig. 408). The inside of the box inlay was filled with cement through the hole in the cavo-surface, the cavity of the tooth lined with cement and the inlay then cemented to position (Fig. 409).

The next advance consisted in accurately shaping a matrix of thin pure gold plate or platinum foil—generally the latter—to the exact form of the cavity of the tooth and filling the matrix with gold solder or plate to the form of the contour of the part to be restored.² Fig. 410 shows this method applied to a pulpless bicuspid. A globule of gold was partly fused and attached at the point A in the matrix, and then gold foil or crystal gold was packed around it to the form required, the inlay invested and solder melted into the foil or crystal gold.

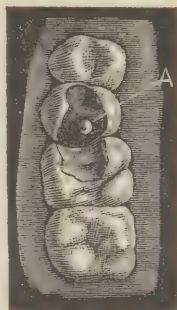


FIG. 410.

This latter method, with improvements respecting the details of the operation, holds good at the present time as one to utilize in special cases.

The great impetus to gold inlay work was the introduction by Dr. Wm. H. Taggart, in 1907, of the method of casting inlays from wax forms or models. Although the matrix gold inlay can be made by an expert to fill the requirements of an inlay, the casting method so simplified the operation for the general practitioner and shortened it for the patient that it immediately took its place as a preferable method.

Merits.—The merits claimed for inlays in operative procedure are:

First.—Absolute closure of the cavity and exclusion of the oral secretions, as the cement lining the walls of the cavity in combination with the burnished edges of the inlay—where gold is used—hermetically seals it.

Second.—Complete restoration of contour.

Third.—Efficiency and durability of occlusal surface compared with the average gold filling.

Fourth.—The cement lining is more benign to the dentin than gold and acts as a thermal and electric non-conductor to protect the pulp.

¹ Dr. H. B. Tileston.

² Dr. W. V. B. Ames.

Fifth.—Relieves the operation of the tedious and laborious work, at times most exhaustive to operator and patient, incident to and connected with the insertion of large gold fillings.

Sixth.—Easily permits restoration with gold, in many cavities in the posterior teeth that otherwise would be filled with amalgam.

Criticism.—The merits of inlay restoration as above outlined are criticised on the following points:

First.—That inlay construction and insertion require a form of cavity which demands the removal of tooth structure which could be advantageously retained by other methods.

Second.—That in cases of approximal cavities in bicuspid and molars on one side—especially when both sides of the crown are involved—the buccal and lingual cusps are weakened by the extensive removal of tooth structure required to secure a suitable form of cavity and a reliable anchorage.

Third.—That the extensive removal of tooth structure required in inlay work renders many teeth hypersensitive and causes progressive calcification of the pulp.

Fourth.—That the percentage of decay which occurs at the cervical margins of inlays is greater than with fillings.

Fifth.—That the more extensive the decay, the poorer the tooth structure and the greater the liability to recurrence of decay,—especially at the cervical section,—proportionately is an amalgam filling more suitable for restorative purposes than the inlay.

Sixth.—That the presence of dentin and enamel capable of resisting decay is preferable to gold or porcelain; therefore the requirements in cavity preparation for the insertion of fillings have the advantage over inlays.

Impartially Considered.—Inlay-work is a valuable acquisition to dental practice. As a comparative innovation, the exact sphere of its application and usefulness is not yet as clearly defined as it will be. The adoption of inlays in operative dentistry to the exclusion of other methods, wholly or in part, by many practitioners, will in time when their merits have been more truly tested and are better understood, be modified by a more rational interpretation.

The general opinion in conservative practice seems to be that in the anterior teeth where the cavities are so situated that the appearance of gold fillings is objectionable, porcelain inlays should be used; that gold fillings are best inserted where cavities are small and invisible, but when such cavities are large, gold inlays are preferable; that in the posterior teeth the gold inlay may be used when the cavity re-

specting location, size and condition suggests, in preference to the packed filling.

When gold is to be used as an artificial restorative agent in teeth exhibiting a soft and brittle condition of the enamel, a gold inlay can undoubtedly be more advantageously inserted than a gold filling, as the latter requires to be condensed against the enamel edges of the cavity where the former is cemented. Accordingly suitable cavities for inlay work may be classed as follows:

First.—Medium or large-sized cavities so located that formerly the operator preferably inserted gold fillings.

Second.—Large gold restorations requiring to be contoured against the adjoining teeth to protect the gum septa, the forming of which with gold foil would be difficult and laborious.

Third.—Extensive restoration of the coronal section of a tooth in preference to the use of a gold cap.

Fourth.—Restoration on an occlusal surface with gold and knuckling it against adjoining teeth so as to leave the interproximal space open and free and provide room for the gum septa; also, incisive edges—when permissible; and exposed cavities and fractured portions of the front teeth with porcelain.

Cavities unsuitable for inlay work may be classed as follows:

First.—Cavities so located respecting position and decay that they are extremely difficult to effectively treat.

Second.—Cases where extensive cervical approximal decay exists, and where to cut parallel walls would involve the removal of a large quantity of enamel and dentin that could be allowed to remain by using a combined cement and amalgam filling.

Third.—When the age or health of the patient or the extreme hypersensitiveness of the dentin is not favorable to an extensive removal of tooth structure such as the case would require for inlay-work.

Fourth.—When the condition of the teeth and the secretions of the mouth are such as to suggest a recurrence of decay as likely at the margins of a filling or inlay or on the adjacent surface of the structure of the tooth.

Preparatory Treatment in Inlay Work.¹—In cases of approximal cavities, it is advisable to pack the interproximal space previous to the operation for the purpose of separating the teeth enough to secure a slight additional space, also to press from position the gum septum and expose that part of the cervical section of the tooth. Some operators claim that no additional space is required beyond that obtained by the necessary removal of the contour of the tooth.

¹ The description here given applies closely to porcelain as well as gold inlay work.

Cervico-buccal cavities close to or extending under the gingival margin should be packed with gutta-percha previous to the operation to expose the cervical section. This is done by inserting in the cavity an excess of the gutta-percha and pressing the excess against the gingiva.

Desensitizing the cavity is advisable when conditions suggest it. Any preferred agent for the purpose may be inserted in the cavity when the space is packed. When decay has closely approached the pulp the dentin should be sterilized, as described in Part II, Chapter I, and the pulpal section of the cavity filled with zinc oxyphosphate cement. When the cement is set it is removed sufficiently to give proper form to the cavity for the inlay.

Principles Governing the Preparation of Cavities

The principles governing the preparation of cavities for gold and porcelain inlays are generally the same. The floor or pulpal wall is shaped as flat as the form of the teeth will permit without encroaching on the area of the pulp. The side walls are trimmed so that their junction with the floor forms a slightly obtuse angle. The line of the

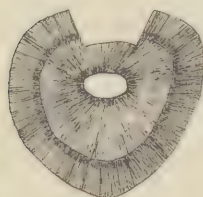


FIG. 411.

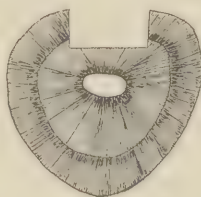


FIG. 412.

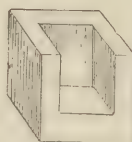


FIG. 413.

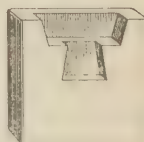


FIG. 414.

side walls should be placed as nearly as possible parallel with that of the enamel rods *tapering outward towards the edge of the enamel*. Fig. 411 shows the correct and Fig. 412 the incorrect form. A very slight bevel at the edge of the enamel is advocated for gold, as it is more effectively burnished against a beveled than a straight margin. For porcelain inlays the edge should be square to avoid a fragile thin edge on the inlay. There should be no undercuts. The cavity should be of sufficient depth to afford retention for the inlay. The form given should allow insertion and withdrawal of a wax model of the cavity or a metallic matrix in a direct line with the walls of the cavity.

Anchorage.—An inlay that is not anchored is entirely retained by the cement. Inlays in labial and buccal surfaces, also positions where no force is exerted to dislodge them and in occlusal cavities where the

force is direct can generally be retained by the cement alone. Contoured inlays in positions where a leverage or lateral pressure is exerted in occlusion and mastication are liable to be dislodged unless anchored by being compound-mortised or locked in the adjoining tooth structure. Inlays used as abutments for bridge-work require to be so anchored. The principle of the mortise as a mechanical device is illustrated in Fig. 413, which shows the simple form and in Fig. 414, a compound mortise. This principle of anchoring inlays is practiced in all operations in which they are required to withstand force that otherwise might loosen them, and especially where they are used as a support in bridge-work.

Preparation of Cavities

In the preparation of a cavity, first, with a sharp, suitably shaped chisel cut down all the frail enamel wall around the margins until healthy enamel is reached. Next, with spoon-shaped excavators



FIG. 415.

remove decayed and affected dentin, cutting from the center toward the edges in the line of the dentinal tubuli as less painful to the patient, and also to avoid accidental exposure of the pulp.

The extent of the cavity having been outlined by this preliminary excavation, sharp rose-head and round burs may be used to remove remaining affected dentin. Overhanging edges of enamel caused by the excavation of the decayed dentin are next removed with suitable sized cone-shape and fissure burs, finishing with small round and tapering oblong carborundum points (Fig. 415). Towards and at the cervical section of sensitive teeth, the shaping and finishing should be done entirely with carborundum points, using first coarse and then fine. They are less painful than burs, trim rapidly and leave a finished surface. Carborundum points should be kept wet and used with a steady hand in either the straight or right-angled handpiece. Small circular knife-edge stones are useful for opening fissures or to assist in cutting away a portion of the central section of the occlusal surface of a tooth

for the purpose of forming an anchorage for an inlay. Oblong tapering Arkansas-stone points may be used for the final finish of the edges.

When the required form has apparently been given the cavity, it may be assured by making a test. This is easily done by pressing a piece of softened base-plate gutta-percha into the wet cavity, chilling and removing. If there is an interference, it will be indicated by resistance in the act of removal. An examination of the gutta-percha will show the point or points which require trimming.

Gold Inlays.—The description of the preparation of the cavities for gold inlays in the following located positions will largely cover the subject.

Labial, Buccal and Occlusal Cavities.—Fig. 416 shows a labial cavity in a superior cuspid that extends under the gingival margin,

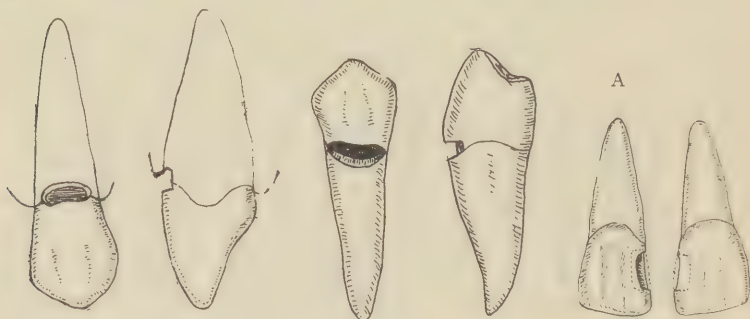


FIG. 416.

FIG. 417.

FIG. 418.

where a gold inlay is frequently inserted in preference to porcelain, especially when the lip does not expose it.

Fig. 417 shows a cavity of the same class prepared in an inferior bicuspid.

Approximal Cavities.—Fig. 418 shows an approximal prepared cavity in a left central incisor. Viewed from the lingual side (A) two square corners are seen formed for retention. In the cuspid shown in Fig. 419 the contour required to be given the inlay calls for a more extensive anchorage. These inlays are inserted laterally. Fig. 420 shows a prepared cavity in a left central incisor that involves a portion of the incisal edge. A is the labial and B the lingual side. The dotted line indicates the form of the cavity and inlay.

Fig. 421 is typical of the formation of an approximal cavity in a molar. In this class of cavities in bicuspid and molars, likewise cavities in all teeth where the inlay has to be inserted in an occlusal direction, the approximal side should be cut straight from the occlusal

surface to the line of the cervical edge of the cavity, and then given a very slight outward flare. Attention is called to the anchorage made in the occlusal surface with level walls at a slightly obtuse angle to the floor or pulpal wall; also the level cervical wall slightly rounded at the corners. This latter mentioned cervical section, termed the "step," is extended under the free margin of



FIG. 419.

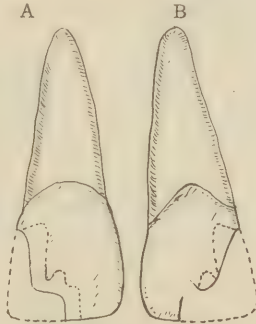


FIG. 420.

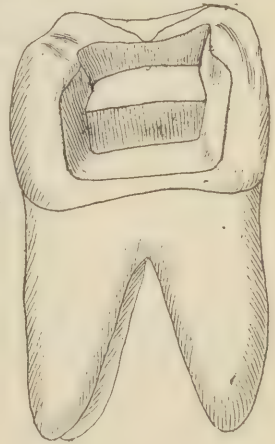


FIG. 421.

the gum for the purpose of substituting tooth structure with the inlay, and thus more effectively resisting the recurrence of decay. This method of preparing a cavity is what in dental parlance is now termed "Extension for Prevention."

It is, however, only the principle practiced and advocated in the past in a conservative way by experienced operators. It is not advisable to practice this method in an extreme manner, as, where strong, sound dentin is present and apparently more than average immunity to future decay of the teeth; nor in the case of nervous patients with teeth extremely sensitive to excavation of the dentin and to thermal changes. Fig. 422 illustrates in section the "step" and also a groove or anchorage that may, when conditions suggest it, be added as an anchorage lug.

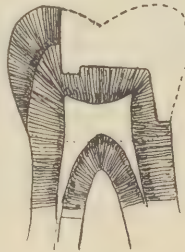


FIG. 422.



FIG. 423.

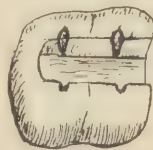


FIG. 424.

Fig. 423 shows the form of an inlay in the approximal side of a bicuspid. The cavity in the occlusal surface was shaped oval instead of square as in the molar, to lock or anchor the approximal section. In many cases, oval-shaped anchor-

age cavities are preferable to the angular. Fig. 424 shows a method of anchoring an inlay with notches ground in the sides of the cavity.

In occlusal cavities in bicuspid and molars where the decay has involved the surrounding walls extensively, they should be ground down, as shown in Fig. 425, and the entire occlusal surface reproduced in gold.



FIG. 425.

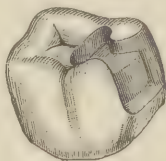


FIG. 426.

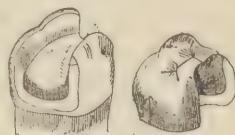


FIG. 427.

Bicuspid and Molar Approximal Plate Extension Inlay.—This consists in the removal of the approximal surface beyond the line of



FIG. 428.

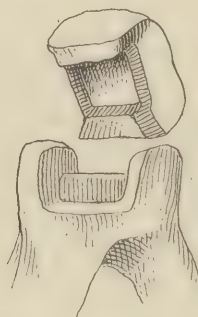


FIG. 429.

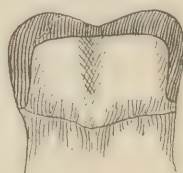


FIG. 430.

the cavity and extending over the flat surface the gold of the inlay contoured to the form of the portion removed, as shown in Fig. 426



FIG. 431.

This extension protects a larger surface of tooth structure against the action of the secretions but increases thermal conductivity to the area of the pulp. This form of inlay is also applied to compound cavities.

Compound Cavities.—Fig. 427 shows a prepared compound cavity that involves both approximal surfaces and unites them by extension through the occlusal surface. By this plan one inlay anchors the other. In such cases, the axial walls must slightly converge toward the occlusal surface to admit withdrawal of the wax without change of form.

In most of these cases it is advisable to grind down the cusps and occlusal surface and reproduce them in gold, as shown in Fig. 428, a

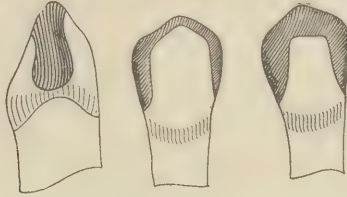


FIG. 432.

bicuspid, and Figs. 429 and 430, a molar. When this is not done, slanting fracture of the buccal or lingual section of the tooth is liable to occur, owing to removal of the dentin and enamel intervening between and connecting the cusps.

Fig. 431 is a central incisor in which the approximal, a portion of the lingual and labial sides and the entire incisal edge are reproduced in gold. Fig. 432 is a cuspid treated in the same manner. In these cases the inlay is inserted in an incisal direction.

CHAPTER XVII

PARTIAL CROWN-WORK, CONTINUED

Gold Inlay Formation.—A gold inlay is made by casting in the mold of a wax model of the cavity, or by fusing the metal in a platinum or gold matrix. The wax model or matrix is shaped either directly in the cavity of the tooth in the mouth or indirectly in a model of the cavity from an impression. The former is called the *Direct Method*, the latter the *Indirect*. (See The Casting Process, page 43.)

DIRECT METHOD

The model is made of inlay wax which is formed in conveniently shaped pieces of different sizes, such as are shown in Fig. 433. Place a piece in warm water, not over 140°F., until it is thoroughly softened.



FIG. 433.

Dry heat is not suitable. The wax may be slightly pressed between the fingers to give it form but it should not be manipulated. The suitable shaped end of the piece of wax—which should be smaller than the orifice—is placed in the cavity and the mass pressed with the fingers so that the wax will be forced against all the walls and exude outside. Let the wax cool slightly, partly trim off the surplus, then soften the occlusal surface with a heated spatula and instruct the patient to occlude the teeth, first directly and then make the lateral movements.

The wax is shaped to the required form with a warm spatula. Trim from the center toward the margin to avoid disturbing the adaptation of the wax to the edge of the cavity. The approximal side, especially at the cervical edge, may be smoothed by drawing across the surface a strip of thin celluloid or silk tape, imperceptibly coated with glycer-

in. On the occlusal surface and sides a pellet of cotton twisted on the end of an instrument and slightly moistened with glycerin, should be applied to smooth the occlusal surface and exposed sides.

As the wax model will be accurately reproduced in every detail in gold, the wax should be trimmed to the exact form required and imperfections or any excess avoided as it is much easier to trim the wax than the gold. The warmth of the mouth keeps the wax moderately

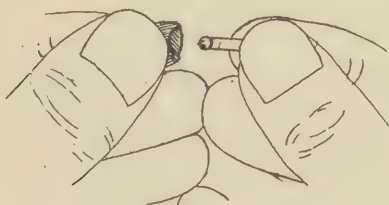


FIG. 434.

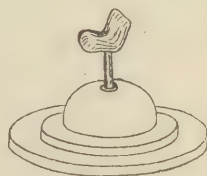


FIG. 435.

soft. When properly shaped the wax is chilled with a stream of cold water and carefully lifted from the cavity without change of form.

When necessary to remove the wax model from the cavity to trim, it should be placed again in warm water to soften the wax before replacement in the cavity.

The finished wax model is lifted from the cavity with a small pointed instrument. A sprue wire is heated and the extreme point thinly veneered with an atom of adhesive wax. The wax inlay is held between the fingers of the left hand and the point of the sprue wire introduced into the most suitable part of either the occlusal or approximal surface (Fig. 434).

The inlay on the sprue wire is next mounted, in the circular plate of the casting flask (Fig. 435) and the flask ring set around it. Investment material is mixed and the inlay invested and cast, as described in Casting, Part I, Chapter VII.



FIG. 436.

An inlay inserted in the occlusal and mesial or distal side of a tooth is termed respectively a mesial-occlusal or distal-occlusal inlay, and when on both sides and occlusal surface a mesial-occlusal-distal inlay.

Pin Anchorage for Gold Inlays.—When an inlay is contoured and the stress of occlusion is liable to cause its displacement, a pin or pins ought to be inserted in the dentin from the inlay at the side opposite

the contour to counteract the leverage. Such an anchorage is also advisable when an inlay is used as an attachment for a bridge (Fig. 436). (See page 316.)

Hollowing of Gold Inlays.—Large inlays may be advantageously hollowed out from the direction of the pulpal wall or floor. This reduces their weight and expense, also aids their retention by the formation of a large undercut. The wax is removed from the center of the inlay, avoiding distortion, with a small hollow tube, the end of which is heated, introduced into the wax and the melted wax drawn out into a

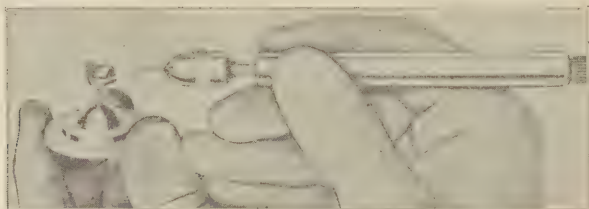


FIG. 437.

chamber filled with cotton by sucking on the tube. Fig. 437 is Roach's instrument for this purpose.

Fig. 438 illustrates an instrument termed a vacuum wax carver.¹ It is to be placed on the point of an electric hot-air syringe and will melt and effectually suck out any quantity of wax. A, in section, illustrates the construction, and B, the actual size of the instrument.

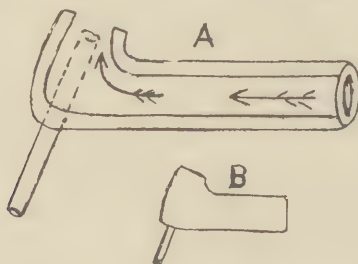


FIG. 438.

Matrix Gold Inlays

The use of the matrix method of constructing a gold inlay, which preceded in practice the cast form, is at present mostly confined to cases for which it has special merit. Such cases are anchorage inlays,

¹ Manufactured by the Electro-Dental Mfg. Co.

incisal tips and small corners on the front teeth, small and moderately large occlusal cavities in bicuspid and molars; also many cervical and buccal cavities, and, in fact, many cavities requiring little or no contour.

One of the advantages of the method over casting for many simple cavities is that one expert in matrix formation can occasionally make and insert an inlay immediately in a fraction of the time required for a casting operation. Another is that where the inlay is intended to assist in retarding the wearing away process termed attrition, in cases of mechanical abrasion, the inlay or tip can be conveniently made of the hardest of the alloys of gold, such as clasp gold or some other hard alloy.

Process of Formation.¹—The cavity is prepared in the same manner as in the casting method. The matrix is made of $\frac{1}{1000}$ gage platinum. Either $\frac{3}{1000}$ pure gold or 2 to 3 per cent. platinized gold may also be used. Preference is given to the platinum because it is more rigid than gold when adapted and is not so liable to be melted in any process connected with the work and therefore does not necessarily always require investment. It is not as easily adapted to the cavity as gold, but folds of the foil on the cavo-surface of the matrix not located at the edge are not material, as all will be united by the gold and become part of the inlay.

Ample spaces between teeth obtained prior to the operation and exposure of the cervical margins of cavities are as necessary as in the casting method.

A piece of $\frac{1}{1000}$ inch platinum foil which has been annealed in an electric furnace, at not less than 2200° F., is cut sufficiently large to cover the cavity and extend beyond it, so that the surplus can be held by the fingers on the sides of the tooth or surfaces of those adjoining. Place the foil over the cavity and with a ball of cotton, spunk or a soft-rubber point press the foil down into the cavity to define its position. While the surplus is held securely with the fingers, next remove the cotton or spunk and by rotating various sized ball-pointed burnishers on the platinum gradually bring it down to the bottom and sides of the cavity. In the operation the foil may be cracked, but if the cracks are small and do not extend to the edges of the cavity, they will be bridged over by the gold and will not affect the inlay.

When the matrix is adapted and in the cavity, pack in sufficient Corona gold or foil to cover the floor and fill or nearly fill the matrix, as already described and illustrated in Fig. 410. The gold aids in re-

¹ A description with illustrations of matrix formation for porcelain inlays, with which that for gold inlays is identical, will be found in Part VI, Chapter VI.

taining the form of the matrix when removed, and in carrying the fused gold over any cracks or imperfections present in the platinum. The matrix is removed from the mouth, laid on a soldering block and a few small pieces of 20-carat gold solder or plate are carefully melted into the matrix with a blowpipe flame so that it will be absorbed by the Corona gold or foil and only reach the matrix walls.

The matrix is again adjusted in the cavity and very accurately burnished to the margins. To the gold already attached enough foil or Corona gold is added to fill the cavity and shape it to the desired form. The matrix is again removed and the cavo-surface given a coat of moistened rouge and invested, leaving the occlusal surface exposed but the edge of the matrix covered. More solder—a little at a time—is fused by degrees on the surface of the gold already in the matrix in quantity only sufficient to properly form the inlay, as an excess necessitates its removal.

After soldering, adjust in the mouth and, should any point require additional gold or slight shaping, again add Corona gold and solder. When formed, boil in acid, cut away surplus matrix, do any necessary finishing and cement in the cavity.

Solid Gold Tips for Abraded Pulpless Anterior Teeth.—These are usually made for cases of mechanical abrasion not suitable for porcelain, and when the appearance of gold will not be objectionable to the patient.

Solid gold tips for abraded pulpless anterior teeth are constructed in the following manner: An opening is made through the occlusal surface of the crown into the root-canal. A flat post is formed wide enough to fit closely in the pulp-chamber across its greatest diameter, thus tending to prevent any rotary motion of the gold tip. A piece of pure gold plate, about gage No. 30 to 32, is adapted and burnished, with hand burnishers and steel or Herbst revolving agate points, into all the irregularities of the abraded surface and the orifice of the pulp-chamber. The gold is next trimmed flush and even to the edges and burnished just over them. An opening is made in the gold plate and the post inserted through it in position, fastened with wax, removed and soldered to the plate. The post and plate are inserted in position, and the end of the post cut off to the exact length the gold tip requires to be, and the gold again burnished to the edges of the tooth and trimmed closely (Fig. 439). The end of the post defines the length and takes the form of a hard plug in the center of the finished inlay.

Wax cement is placed on the gold and shaped to the exact form of the required gold tip (Fig. 440). The sides of the wax model are next encircled with a strip of $\frac{1}{2}$ 000 platinum or No. 60 gold foil adapted to

the surface of the wax. This foil strip is to form a matrix. All parts are now removed and invested (Fig. 441).

The investment is next heated and 20-carat gold solder melted into the matrix formed by the foil encircling the plate, through the open incisal edge. The surplus gold at the sides is trimmed to the surface of the tooth and the desired form of the tip, and polished. Platinum foil, when used, becomes invisible when the surplus is removed in the

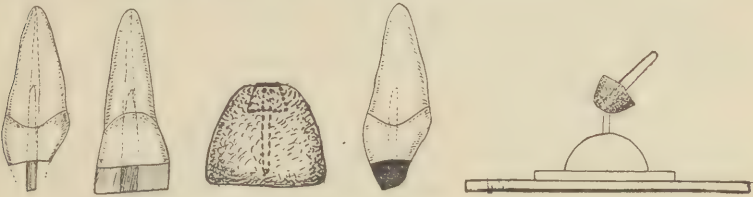


FIG. 439. FIG. 440. FIG. 441. FIG. 442. FIG. 443.

finishing. The trimming or polishing of that part of the tip adjacent to or fitting against the incisal portion of the tooth should always be done with the tip in position on the tooth. The gold tip when finished, is cemented with a thin mixture of oxyphosphate cement. Fig. 442 gives a sectional view of a central incisor tipped in this manner.

The Casting Method.—Inlay wax is placed on the end of the fitted pin, the pin is adjusted to position in the tooth, the wax pressed against the abraded surface and shaped to the form of the tip. It is then removed, invested and cast. Fig. 443 shows the tip ready for investment.

Cases of Vital Pulp.—In these cases two or three small platinum pins, gage No. 20 or 21, as the case may suggest, are used in holes drilled around the pulp-chamber in the manner shown in Fig. 444. Three pins should always be used except in very small lower incisors where the space will not permit more than two. The pins should be inserted and soldered one at a time in the gold or platinum plate which has been fitted to the abraded incisal surface of the tooth, the plate being readapted each time. The first pin, if fitted tightly in the hole through the plate, may be soldered without investing, but an investment should be made for the soldering of each subsequent pin, as otherwise the previously soldered pin or pins are liable to be moved from correct position. The least possible quantity of solder should be used on the first two pins. After all the pins have been soldered in position in the plate, it is adjusted on the

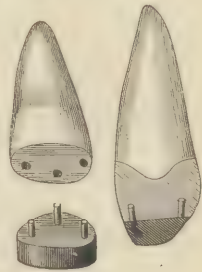


FIG. 444.

tooth and the gold very carefully burnished with revolving burnishers to its surface, trimmed, and the ends of the pins cut off so that they just touch the antagonizing teeth when occluded. The floor is next shaped up with wax and a matrix formed, as previously described, invested and the matrix filled with solder. The gold tip is then finished and cemented.

In a case with a vital pulp or in a pulpless tooth, if the gold tip required is very short, the ends of the pins extending above the plate will hold and maintain enough solder in position to furnish material for proper contouring without enveloping the wax model with a matrix of gold or platinum foil.

Another method¹ of building the tip to any required length is: Having made and invested the plate with the three pins for the abraded surface of the tooth (A, Fig. 445), roll down a piece of solder very thin,



FIG. 445.



FIG. 446.



FIG. 447.

about gage No. 33 to 34, cut it to the size of the plate and punch holes in it for the pins to protrude through (B). Next cut a piece of 20 or 22-carat gold plate or clasp gold to the same size and also punch holes in it for the pins in the same manner as for the solder (C). Place the solder on the plate and the supplementary plate over the solder, and apply the broad flame of the blowpipe. When the solder melts, the supplementary piece of plate will settle into position. If one piece of plate does not give sufficient length to the tip, attach in the same manner another layer of gold solder and plate. When extreme hardness is required, use clasp gold instead of plate. If three pins are used, it is very seldom necessary to extend the plate for stability beyond the incisal surface over the lingual side of the tooth. A slight depression in the incisal surface may be formed if it does not already exist in the central part between the pins, as shown in section in Fig. 446. This depression aids in steadying the finished tip.

¹ Dr. Milton Smith's method.

Fig. 447 shows the reproduction of the occlusal surface of a molar by the methods described, in which three pins are inserted. Some cases of reproduction of the occlusal section may be done to advantage by the casting method. In such cases the matrix should be made of platinum, gage $\frac{1}{1000}$, and the pins are best soldered with 15 per cent. platinum solder instead of pure gold.

When pins are used to retain a gold tip in the reproduction of an occlusal surface, the matrix method is generally preferable.

When the entire "bite" is to be opened, one tooth on each side should be first elongated and used to gage the space for the lengthening of the others.

CHAPTER XVIII

PARTIAL CROWN-WORK, CONTINUED

Indirect Method

The construction of inlays by the indirect method differs from that already explained in that the work is done on a model instead of directly in the mouth.

Comparative Merits.—In the direct method the labor of taking an impression and making a die and models is avoided and accuracy of the occlusion in the finished inlay is assured.

By the indirect method the formation of the wax inlay model is comparatively simplified, especially in positions difficult to reach in the mouth. In removal of the wax model, distortion of the body or edges is less liable to occur, a matter difficult or impossible to correct in the cast inlay. Any slight discrepancies in the cast inlay are more easily detected and corrected by the metal model than they can be in the mouth.

As articulating models can seldom be depended upon as absolutely correct, inaccuracies of the occlusal surface are more liable to occur in their use than when made directly in the mouth. Such inaccuracies call for alterations which are not always as easily made with gold as with porcelain and which at times destroy the sulci and cusps which have involved labor and skill in their formation.

Impression Materials.—Inlay impression compound that softens at a low temperature, hardens quickly and reproduces the smallest details of form is generally given the preference for taking impressions to other materials.

Process.—The impression compound is softened by dry heat to a doughy consistence, the proper quantity is then placed in a cap, tube or tray with a cone-shaped extension to press into the cavity. Just before the impression is taken the cone and the surface of the compound are additionally softened by holding above a flame for a moment. The softened part, especially the cone, is then more easily pressed into the cavity and the harder part back of it offering greater resistance forces the soft portion forward. The surplus compound that is forced

out of the rear end of a tube should be pressed back at once, forming a piston to drive the soft portion into the cavity and onto and over its edges.

An impression should be allowed to remain in position before removal until the compound is hard. The hardening may be hastened by the application of cold water or a draught of cool air.

Impression Tubes, Caps and Trays.—Various forms of small impression tubes, caps and trays are given preference for gold and porcelain inlay impressions. The use of caps and tubes is confined to those cases where the impression is inserted and removed in an incisal or occlusal direction, such as approximal-occlusal, occlusal and incisal cavities. Trays are used generally, but especially for cervico-labial and buccal cavities and such approximal and other positioned cavities as require the impression to be removed in a more or less lateral direction. In the use of tubes and caps, the metal partly or entirely surrounds the tooth, and with trays, only fits over the cavity and adjacent portion of the crown. In the use of either form, the metal when trimmed should always be allowed to entirely cover the cavity and extend beyond the margin at least one-eighth of an inch on the surface of the crown and one-sixteenth of an inch on the root at the cervico-approximal section.

Formation of Tubes and Caps.—These are generally made of copper No. 32 or thinner, and when annealed are very flexible. (See Part I, Chapter V.)



FIG. 448.

The tube or cap used should be one selected or made which will closely fit over and encircle the tooth. Fig. 448 represents, in section a tube fitted to a molar. The dotted line indicates the position a cap would take if used instead of a tube. Fig. 449 illustrates the Roach impression cup or tray with a hole for a detachable handle. The cup should be bent and trimmed to the form of the tooth and requirements of the case, the same as a tube would be.

Methods of Forming Trays and Taking Impressions.—Trays are generally made to meet the special requirements of a case. German

silver plate or an alloy of nickel and silver termed platinoid, about No. 30 gage, is very suitable. The plate is cut and bent to fit the approxi-

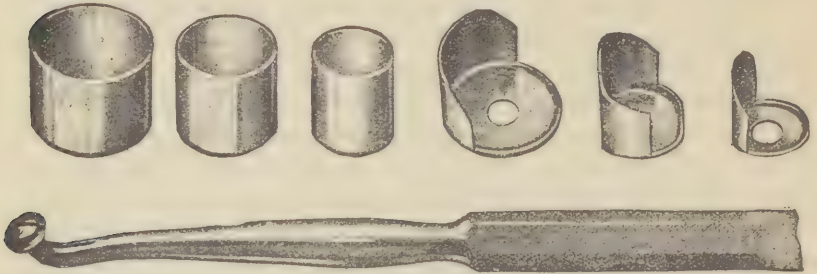


FIG. 449.

mal space and side or sides of the crown, or to cover only the cavity and a portion of the crown, as in cervical and occlusal cavities.

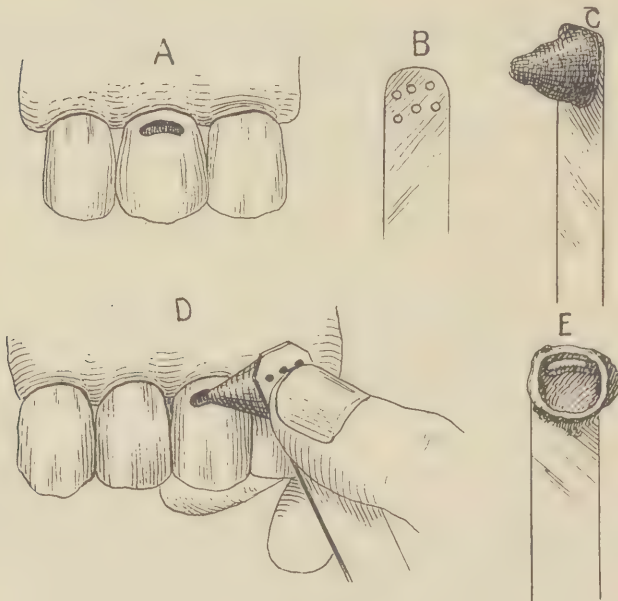


FIG. 450.

A simple labial cavity,¹ as illustrated at A, Fig. 450 will be used as a typical case to explain the formation and use of a tray. A strip of

¹ Dr. F. T. Van Woert's method of formation is here presented.

platinoid is cut to the shape shown at B, and perforated with a plate-punch to aid in retaining the impression compound.

A small piece of the compound is softened over a flame formed in a cone on the tray, as shown at C, the tray being first heated sufficiently to secure good adhesion. The cone is then partly chilled by dipping it in cold water, after which the point of the cone is softened by holding for a moment in a flame and then quickly carried to, and pressed into the cavity with the index finger resting against the lingual side of the tooth, while the thumb carries the compound to place, as shown at D, and holds it rigid in position during the cooling. When occasion requires, the position of the fingers may be reversed. The removed impression is shown at E.

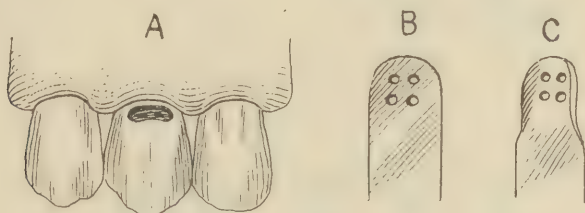


FIG. 451.

The hardening of the compound may be hastened by cold water. If the cavity has been properly prepared, the tray correctly shaped and the compound suitably applied, the impression is usually dislodged without much difficulty. The imprint of the cavity and margins should be sharply defined. Rough places indicate either faulty shaping of the cavity or imperfections in the impression.

In cervical cavities extending under the gingival margin it is advisable to first prepare the cavity for the inlay, pack it with gutta-percha and press back the gum for a day or two before taking the impression. In such cases the tray should be shaped and curved so that, if necessary, one edge may be forced up under the gum between the soft tissues and the concealed margin of the cavity. The compound is attached to the tray, leaving the extreme edge exposed, or nearly so, and the edge introduced beyond the concealed margin of the cavity before the tray is pressed down.

In cases where there is convexity of surface, such as is illustrated at A, Fig. 451, the metal is cut and bent in forming the tray to accurately fit over the tooth surface as shown at B and C.

When a cervical cavity extends around the approximal side, as



FIG. 452.

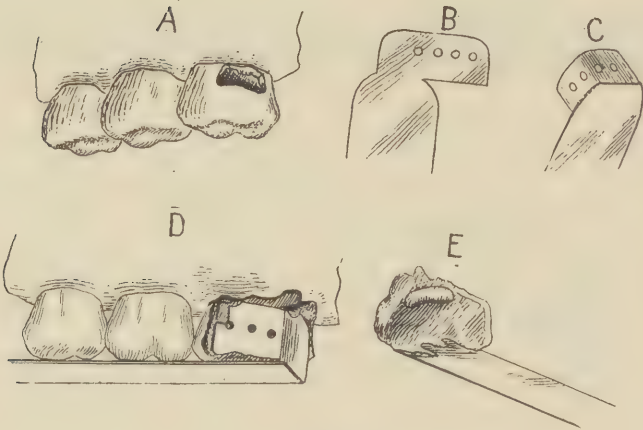


FIG. 453.

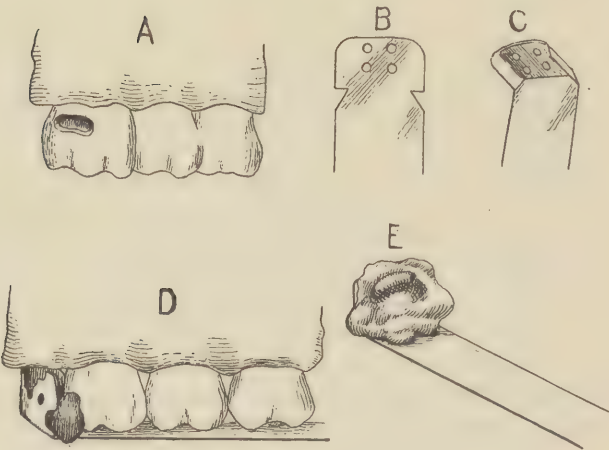


FIG. 454.

illustrated at A, Fig. 452, the metal should be cut and the tray shaped as shown at B and C.

In cases of molars, as illustrated at A, Fig. 453, the tray is formed and impression taken, as shown at B, C, D and E.

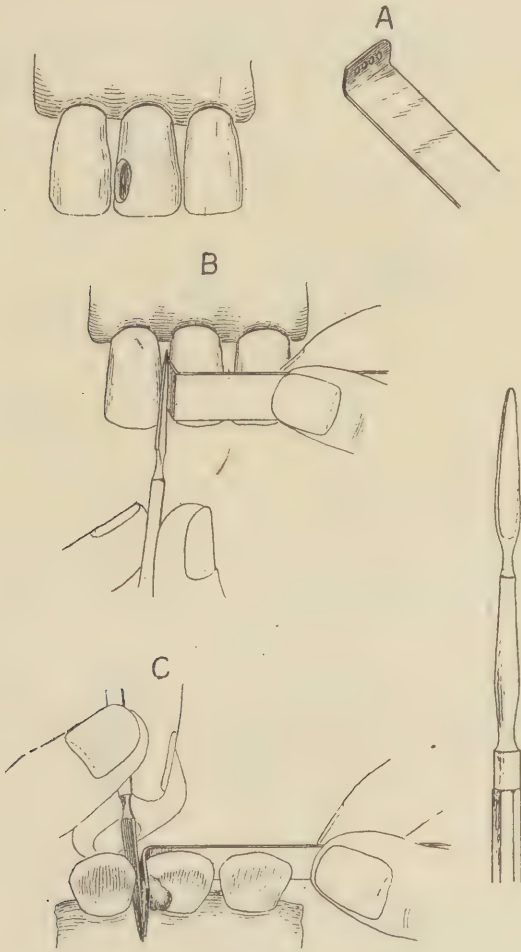


FIG. 455.

For a cavity wholly in the distal surface of a molar with space posterior to it, as shown at A, Fig. 454, the tray is shaped and impression taken, as shown at B, C, D and E.

The taking of approximal cavity impressions in trays is more complex

than those just explained. Fig. 455 shows a cavity in the labial approximal surface of an upper central incisor. The tray is shaped, as shown at A. Only enough metal is used to completely cover the margins of the cavity and thus avoid injury to the tissue by overhanging edges of the compound, which will interfere with removal of the impression. The surface of the compound is quickly heated and placed in the cavity, as shown at B, and a small cement spatula is forced between the outer surface of the tray and the adjoining tooth.

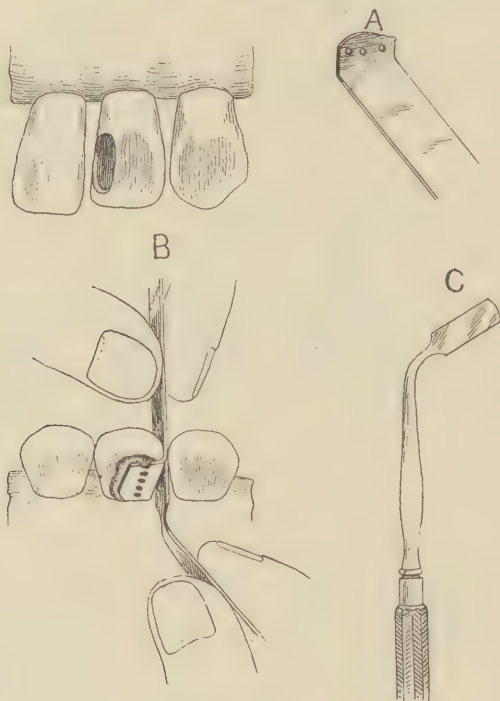


FIG. 456.

After cooling and before removing the spatula, any excess of the compound that may be forced through upon the lingual side, as shown at C, should be cut away with a lance. The spatula is first removed and then the impression. A spatula forced in as described, on being removed, furnishes a slight space for displacement and removal of the tray.

In the lingual approximal surface (Fig. 456) a similar tray (A) is used but it is bent end curved to fit the lingual surface. When the impression is taken, it is pulled to place (B) and a bent spatula (C)

is inserted from the lingual side. Its further treatment is identical with the previous case.

Approximal cavities involving both the labial and lingual surfaces, such as is shown in Fig. 457, present complications, as the impression cannot be removed in one piece but must be taken in a tray formed

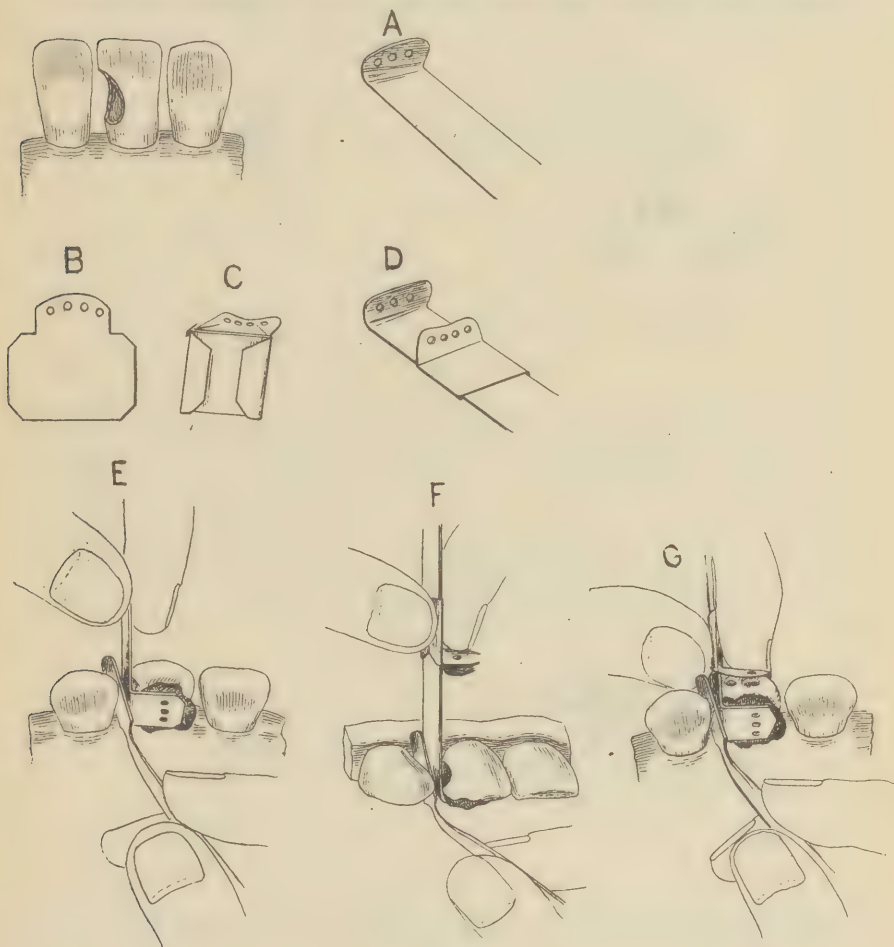


FIG. 457.

in two sections. The first is like that shown at A; the second is cut in shape as depicted at B, and bent as at C. This should fit the first section closely without lateral motion, yet slide up and down freely (D).

The impression is taken by introducing the compound lingually on the first section (E). The spatula should be held in place by an assist-

ant at the angle shown, so that it will not interfere with the second part of the tray, when it is subsequently forced to place.

The surplus compound is next removed and that remaining carved to the contour of the labial surface and flush with the cavity margin, as shown at F. The surface of the tooth and the carved impression are coated with vaselin. The second section (C) is prepared by attaching to its surface a small quantity of impression compound but not

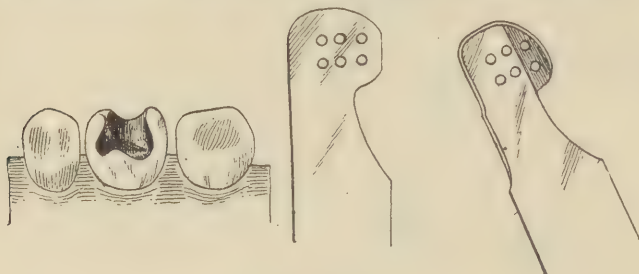


FIG. 458.

enough to press beyond the margins of its attachment. The compound is heated and this second section is slipped over the first section (F) and pressed to place as shown at G. When chilled the second section is first removed, the spatula next and then the first section. After removal the parts are adjusted together and fastened with adhesive wax. If properly performed the result will not exhibit a perceptible seam. This sectional method is applicable to a variety of cases.

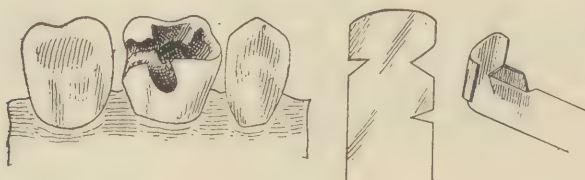


FIG. 459.

Fig. 458 shows the form of a tray and method of shaping suitable for an occlusal cavity extending into the buccal region.

Fig. 459 shows a distal cavity in a molar and the formation of a tray suitable for it. For cavities in the mesial approximal surface, the tray described for the distal approximal surface is to be bent over on itself as seen in Fig. 460.

When a cavity includes the occlusal, buccal and both approximal surfaces, a tray slightly more intricate, such as is shown in Fig. 461 is

required. The main part of the tray is first bent to fit the distal and lingual sides as has been shown in Fig. 459. Next a piece of plate is cut and bent as shown at A and B, Fig. 461, and soldered to the first or main part as illustrated at C.

Fig. 462 shows a tray for a bicuspid where the cavity involves the mesial, occlusal and distal surfaces. The metal is cut and bent, as



FIG. 460.

seen at A, B and C, to form the tray, *which is applied from the buccal side.*

Fig. 463 shows an upper central prepared for a porcelain or gold contour corner restoration. A, B and C show the formation of the tray and D the tray and impression.

When the cavity is deep-seated, as shown by dotted line in Fig. 464, the cavity is first filled with a cone of the impression compound A, and pressed in as seen at B. The surface of the cone is then heated

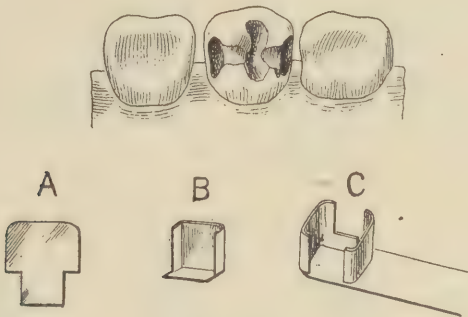


FIG. 461.

with a hot spatula and the impression is taken as in the previous case. When the impression is removed, it appears as though in one piece (C). Before inserting the cone plug, slightly vaselin the cavity to aid removal.

In cases of extensive restoration of the incisal end of a pulpless tooth, represented in Fig. 465, an iridio-platinum post is fitted to the proper depth in the canal and the protruding end flattened. The post is heated, surrounded with a cone of the impression compound A, and pressed to place as in the previous case. The remainder of the impres-

sion is taken in a loose-fitting tube or cap, B and C. Before pressing the tube or cap to place with the impression compound, the end of the

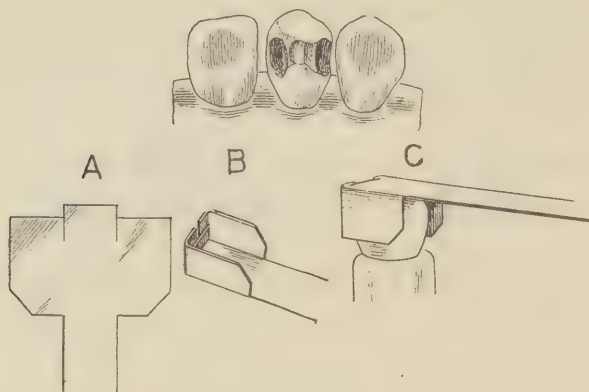


FIG. 462

post and also at the same time the exposed surface of the compound should be heated with a very hot spatula.

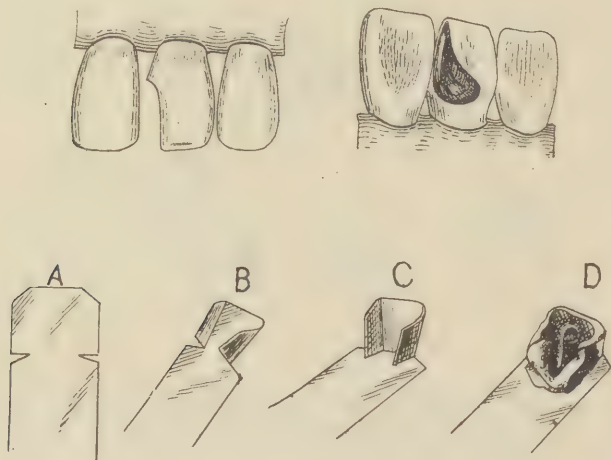


FIG. 463.

In cases of similar restoration for a vital tooth two or three pins of platinum wire, about No. 20 or 21 gage, should be fitted closely but

easily in holes drilled parallel on each side of the pulp, at right angles to the incisal edge, as shown in Fig. 466. The impression is taken in a manner similar to the case in Fig. 465, the pins being drawn in the compound.

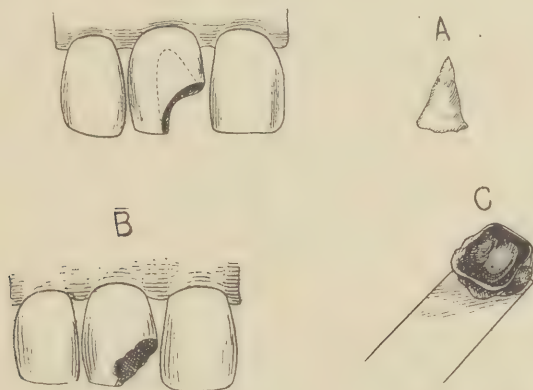


FIG. 464.

Inlay Dies.—Various materials have been recommended for the formation of dies for inlay work. Practical experience suggests amalgam as the most suitable. A silver-tin¹ or copper amalgam is most used. The silver-tin amalgam is preferred to the copper, as it hardens quickly.

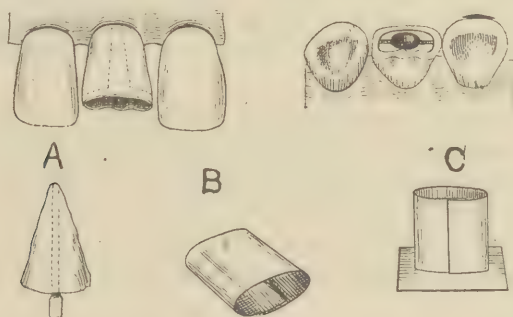


FIG. 465.

The copper amalgam is less expensive as it can be used several times. (See page 29.)

The die should be inserted in a wax impression of the tooth and the adjoining teeth with "bite" and plaster models made from which the

¹ S. S. White True Dentalloy is of this form.

die may be removed and replaced. To avoid distortion of the wax, run the impression of the occluding teeth first and allow the plaster to set. The shank of the die should be tapered and veneered with wax to permit easy withdrawal from the plaster model.

Indirect Inlay Wax Model Formation.—The process of wax model formation from a model is the same in principle as the process in the mouth. The die may be removed from the model to facilitate the work and replaced again in the model to accurately determine the

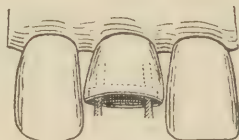


FIG. 466.

contour, also the form of the occlusal surface, by closing the articulating model on the wax. Should the wax become chilled during the operation, the model and wax in position may be immersed for a while in tepid water of about 110° F. The sprue wire is best inserted in the wax model while it is still in the die. The whole is then chilled and the wax model removed.

Metallic Matrices, Indirect Method.—Metallic matrices are shaped on an amalgam model as in the mouth. Any post or pins present in the model are to be attached in position with wax to the matrix, invested and soldered to it. The wax model is then formed and cast in the matrix. For further descriptive details and use of a swager to shape a matrix, see page 502.

Silicate Cement Die for Use in Indirect Method.—A die by which a wax inlay model can be quickly formed, is made by packing into the compound impression silicate cement instead of amalgam. As this cement sets quickly, the die can be removed from the compound impression in about 15 minutes, the wax model of the inlay made and the exact occlusion determined, all in one sitting of the patient.

CHAPTER XIX

SPECIAL OPERATIONS IN CROWN-WORK

Crowning Molar Roots Decayed Apart at the Bifurcation.—The roots of a molar decayed apart at the bifurcation may often be crowned so as to prove serviceable for some time. The roots having been treated the ends are trimmed and paralleled, the one to the other, giving the sides a slightly tapering form. Platinum collars No. 38 gage are made and fitted to each root, reinforced with pure gold, floors added and the two caps soldered together (Fig. 467). An occlusal cast section can then be added. The most serviceable method of restoration in such cases is accomplished with platinum and porcelain. (See Figs. 1038 to 1041 and 1058 to 1062.)

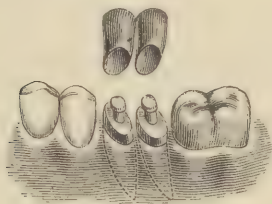


FIG. 467.



FIG. 468.



FIG. 469.

In cases of pyorrhea alveolaris, when the buccal roots of a first superior molar are only slightly affected but the connective tissue of the palatal root is nearly or entirely destroyed,—a condition impossible to treat successfully,—the usefulness of the tooth may be retained in part by the removal of the palatal section of the crown and with it the root.

The buccal roots having been treated and filled, a fissure bur is inserted in the pulp-chamber, and the crown cut in half mesially and distally through its center. The palatal half of the crown and the palatal root are then removed. The buccal half of the pulp-chamber is shaped (Fig. 468) to retain either a gold inlay or an amalgam filling, or preferably a porcelain inlay such as will give form to the part as illustrated by Fig. 469. In case of extensive decay being present, capping with metal may be resorted to.

Cantilever Crown.—A cantilever crown is one with a lug on the side not connected to but resting against an adjoining tooth or crown, for the purpose of bridging a small space. Fig. 470 shows the application of a cantilever crown set upon a second bicuspid with a lug that bridges the space formed by the loss of the first bicuspid and resting on the cuspid so as to connect the broken line of masticating surface and prevent tilting forward of the second bicuspid. Fig. 471 illustrates the application of two cap-crowns which are constructed so as to form a cantilever bridge over a small space, in such a manner as to prevent tilting or sliding of surfaces and at the same time be easily cleaned with floss silk. A single root of a lower molar may be capped with a lug extending to and resting on an adjoining tooth in the manner described in either of these cases.



FIG. 470.

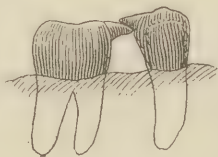


FIG. 471.

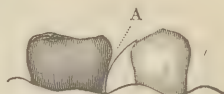


FIG. 472.

Method of Construction.—A lug such as has just been described to span a wide interdental space is conveniently formed by first attaching the edge of a piece of platinum plate about gage No. 30 to the side of the gold crown with wax or solder. The crown is then fitted in the mouth, the platinum bent and burnished over on the adjoining tooth or crown, as shown in Fig. 472, and removed. The space A is filled with wax and the crown invested. The wax is removed with boiling water, the aperture A, filled with gold foil or Corona gold to prevent contraction of the platinum by the solder, heated and soldered. The surplus metal is trimmed away, as indicated on adjustment in the mouth.

Cantilever Inlay.—Frequently a securely mortised or anchored gold inlay in the occlusal surface of a molar may be utilized to support a lug or cantilever extension to bridge a large approximal space between teeth.

Merits of Application of Cantilever Construction to Crowns and Inlays.—This is evidenced by the results obtainable where malposition and malocclusion of teeth require the prevention of the invasion of particles of food into the interproximal space in mastication.

Method of Crowning in Cases of Irregularity.—Fig. 473 shows a method of treating a case of irregularity without destroying the vitality

of the pulp.¹ The tooth at B which stood inside the line of the lower teeth when the mouth was closed, was trimmed, shaped and capped without removing the pulp. To this cap was attached the tooth A,

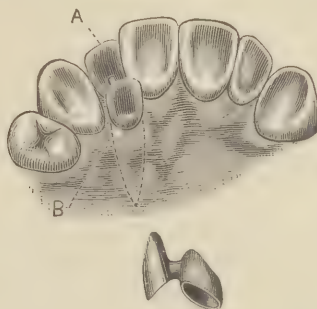


FIG. 473.

with an oval-shaped piece of gold for cleanliness that cleared the lower teeth in occlusion. The cap, which was then cemented over the natural crown, was entirely hidden from view by the artificial tooth or porcelain facing.

¹ Case of the author's.

CHAPTER XX

TREATMENT BY CROWN-WORK OF FRACTURED TEETH AND ROOTS

Fractured Crowns and Roots.—The fracture of teeth or roots is caused either by a blow, or strain of mastication. Fractures are longitudinal or slanting. The longitudinal fracture passes lengthwise through the crown, dividing the tooth into two parts (Fig. 474). The slanting extends from the center or between the cusps to the side on the line of the cervix or beyond it.

The crowning of fractured teeth or roots is an operation that requires skill and delicate treatment. Its practicability depends on the nature of the fracture, the present health of the parts and the length of time that has elapsed since the occurrence of the injury.



FIG. 474.

Longitudinal Fractures.—Foreign substances having been removed from within and around the parts, the crevice of the fracture is syringed thoroughly with tepid saline solution and then with alcohol. The fractured parts of the root are drawn together and ligated with a piece of orthodontia wire fastened by twisting the ends.

If considerable inflammation is present trim the occlusal surface of the tooth and antagonizing teeth sufficiently to remove all pressure and allow the tooth to rest until the inflammation subsides. If there is no inflammation, or only a slight amount, immediately shape up the coronal section for the collar. Trim the sides to the inner line of the wire ligature, fit a copper tube, take an impression of the tooth in impression compound and make an amalgam die. If the condition of the fracture will permit, the ligature should be removed when the impression is taken, but, if not, allow it to remain and trim, also deepen the cervical shank of the die enough to remove the form of the wire. The root-canals should be opened, dried and heated with a current of hot air from a hot-air syringe and packed with a saturated solution of aristol and oil of cloves and sealed with gutta-percha. This treatment, with renewal of dressings, is to be continued until a sterilized condition is established.

The root-canals only are to be first filled and not the trunk of the pulp cavity where the fracture is. Use the silver chlorid or copper oxyphosphate cement instead of zinc oxychlorid in the filling of the canals as there is usually danger of the oxychlorid invading the crevice of the fracture and causing inflammation.

When the collar has been made, the ligature is removed, the collar fitted and the remainder of the artificial crown completed. When the crown is ready to insert, the fractured parts are again syringed with saline solution, then alcohol, and the cavity filled with cotton saturated with alcohol.

The tooth is protected from the secretions, the cotton removed and the cavity dried with hot air. A quantity of silver chlorid or copper oxyphosphate is mixed to the consistence of a thin cream, the fractured parts are slightly separated and the cement gently pumped into the crevice of the fracture and the cavity in the crown filled. A ligature is then instantly applied and made as tight as possible. As the parts are brought together, the surplus cement in the fracture is forced back into the cavity of the tooth. Any pressure the cement may exert against the pericementum is so slight that no serious or permanent inflammation is likely to follow. The tooth should not be disturbed until the cement has thoroughly set. The ligature is then removed and the finished cap-crown cemented on in position. The introduction of the cement in the fracture, as described, shows better results than when confined only to the cavity of the tooth, as by its presence the secretions are more effectually excluded.

The cervical edge of the collar should be brought to a feather edge and thoroughly burnished to the sides of the root. The crown should be favored by leaving a very slight space between it and the occluding teeth. This space will gradually close in time and the tooth may then be better able to withstand the force of occlusion.



FIG. 475.

Another method in the case of molars with comparatively straight root-canals is: With the ligature in position drill the root-canals as deep as possible parallel to each other; fit a post with a long end in each canal, wax and remove the posts together in position, invest and connect with a piece of plate, trim off the surplus ends, as shown in section in Fig. 475 and cement the posts in the roots. Cap with a closely fitted collar crown.

Another method, if the dentin is strong enough to favor it, is to ligature the roots, drill two dovetail slots—one in each fractured section—and having filled the root-canals and the inner section of the pulp-chamber with cement, fill the slots with a hard, quick-setting

amalgam (Fig. 476). In shaping the crown and roots for the gold collar, care should be taken not to loosen the amalgam splint.

A great drawback in these cases is that the patient generally fails to present himself immediately for treatment, and the fracture becomes infected. Even in the apparently most favorable case, subsequent to treatment a septic condition of the fracture usually, in time, supervenes, compelling the patient to resort to extraction.



FIG. 476.

Slanting Fractures.—Fractures of this form occur in bicuspid and molars where large fillings are inserted from the mesial to the distal side, leaving the separated buccal and lingual cusps to bear the brunt of mastication. The fracture seldom extends beyond the edge of the alveolar process. Fractures of this kind usually occur with pulpless teeth.

The fractured part is removed. The hemorrhage is checked and the part anesthetized with cocain and adrenalin. If the fracture extends



FIG. 477.

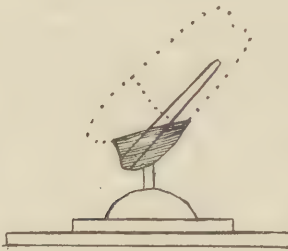


FIG. 478.



FIG. 479.



FIG. 480.



FIG. 481.

below the edge of the alveolus, the bone is removed to the line of the fracture.

The canals are prepared for treatment and gutta-percha packed into the cavity of the tooth and the tissue pressed back to expose the surface and margins of the fracture.

Inlay Casting Method.—In the case of a bicuspid fractured as shown in Fig. 477, a large platinum or iridio-platinum post is fitted into the canal. The post is heated and veneered with adhesive wax. A pellet of inlay wax is softened and pierced with the post. The post is adjusted to position in the canal, the wax adapted and shaped to the form of the lost fractured part and all removed. A sprue wire is inserted in the wax form as shown in Fig. 478, and invested and cast with pure gold. The casting is then polished, the excess of post cut off and the inlay cemented to position with silver chlorid cement.

In such a case the cusps should be shortened by grinding to lessen stress in occlusion.

Fig. 479 illustrates a prepared fractured root, from which the fractured portion has been removed, with a casting for a porcelain-faced jacket-crown, and Fig. 480 for a gold cap-crown.

Amalgam.—The preceding methods present an artificial restoration having a metallic surface only slightly oxidizable, which is not the case when amalgam is used and the surface is left exposed, even though polished. The use of amalgam is preferably confined to fractures which will be entirely covered with the collar; or to those that extend so far under the gingival margin that a gold inlay cannot well be applied.

Post and Amalgam.—A post in a root-canal reinforced with amalgam affords great security. Such an application in the restoration of a bicuspid for a porcelain-face jacket-crown is illustrated in Fig. 481. The post should be made of gold or platinum, with a globule of gold solder melted on the part that will rest in contact with the amalgam. The use of posts or screws made of alloys of the base metals is not permissible.

When amalgam is used to restore a fractured root, the collar of the crown is supposed to cover it except in cases where the restoration is very deep and of a shape that is preferably left uncovered.

CHAPTER XXI

PROCESSES CONNECTED WITH CROWN- AND BRIDGE-WORK

Correction of Excess of Solder.—To correct the accidental presence of solder on the inside of a gold crown, dry the surface of the metal and tooth with a wisp of cotton on the point of an instrument, and with the cotton paint the surface of the natural tooth or root, with a spatulated paste of rouge and oil and then adjust the crown. The interfering spot will be accurately marked on the gold. This should be trimmed with a small carborundum point and the crown again inserted to determine whether enough has been removed. If preferred, the paste may be placed on the inside of the gold crown. In that way the



FIG. 482.



FIG. 483.

interfering point will be marked on the natural tooth or root, which can be trimmed instead of the gold to permit proper adjustment. The latter method is more suitably applied to pulpless teeth.

To Securely Attach a Crown.—These methods apply to cases where the tooth is very short and the occlusion of a character requiring the reduction of the collar to such a degree as to suggest insecurity when the crown is cemented. In such a case with a living pulp, a short barbed or headed pin that will anchor in the natural crown should be soldered in the center of the gold crown, as shown in Fig. 482. This is done by passing the pin from the cavo-surface through a hole drilled in the occluding surface of the crown and cementing with wax. It is then adjusted in the mouth, removed, invested and the pin soldered from the outside. In a pulpless tooth the pin may be extended into the pulp-chamber or a root-canal (Fig. 483).

Importance of Removal of Flux from Interior of Crowns.—Always boil a crown in acid to remove the flux. The removal of the flux from the cavo-surface of a crown is absolutely necessary if it is intended to be used in bridge-work, as solder will have to be melted on the outer surface.

Correction of Interfering Points in Adjustment and Occlusion.

In adjustment, especially of bridge-work, interfering points are indicated by veneering the cavo-surface of the cap or crown with a paste of rouge and oil. On adjusting the work the interfering point will be marked on the root or tooth, which should be trimmed accordingly. The method can be reversed by applying the rouge on the root or tooth.

In occlusion use marking paper or apply the rouge and oil on a strip of paper and occlude the teeth on the paper. Another method is: Warm the occlusal surface of the crown and veneer it with a film of wax then occlude the teeth on the wax. (See Adjustment and Insertion, page 291.)

CHAPTER XXII

CEMENTATION OF CROWN- AND BRIDGE-WORK

Zinc Oxyphosphate

As a cement for effecting the proper union between the natural tooth or root and the artificial crown, zinc oxyphosphate is the cement generally used. If exposed, even the best preparations are slowly soluble in the mouth and the compound permits it to absorb gases and fluids and gradually become septic. At the present time to impart antiseptic properties to zinc oxyphosphate, compounds of copper are incorporated by several manufacturers in a proportion of at least 25 per cent. A silver chlorid cement has been introduced by The S. S. White Dental Manufacturing Co., which possesses antiseptic properties.

Exact scientific proportions of the chemical substances of which a cement is composed are essential in its preparation. The zinc oxid should be calcined at a high heat and then ground to an impalpable powder. Cement should possess the property of being uniformly dense and hard clear through the center when set, after being mixed thin and formed in a mass. The density of one preparation of zinc phosphate in comparison with another can be tested by placing samples of each of the same size, mixed under similar conditions, in red ink. After immersion for one or more weeks, the samples can be removed, washed, then cut through the center and their comparative density determined approximately by the depth of the stain.

The setting of cement is materially affected by temperature. Thus, a cement which is slow-setting at 50° F. is liable to be quick-setting at 80° F. In some of the preparations of cement, an effort is made to remedy this variation by adulterating with various ingredients, but this tends to increase the solubility of the compound. A standard preparation of cement answering the requirements previously outlined should be used in crown- and bridge-work.

Method of Mixing.—For all styles of crowns with collars and for bridge-work depending on crowns of similar construction, the cement should be mixed to the consistence of a thick cream, but for crowns without a collar or ferrule, it may be moderately thicker. For mixing the cement, a piece of plate-glass about five inches long and three inches

wide as a slab, and a small spatula, are suitable. The surface of the slab should be perfectly clean, and the acid and powder separately placed on the glass—the powder to the right and the liquid to the left—(Fig. 484), the quantity of the powder being fully equal to the requirements of the acid. A portion of the powder should be drawn over and mixed with the acid and then more of the powder added, a little at a time, until a suitable consistence—which is that of a thick cream—is reached, when the surplus powder should be instantly pushed aside and the mixing, which must be rapid and thorough, continued. It is not a good plan to mix cement excessively thin and then wait until it

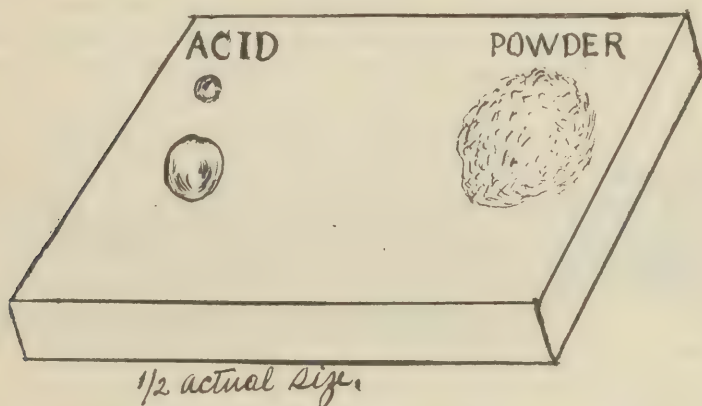


FIG. 484.—One-half actual size.

becomes thickened by the process of setting to a consistence suitable for use. The resulting compound is unnecessarily acid, the overplus of acidity being proportioned to the excess of acid used over the quantity required, and its character as a cement impaired. On the other hand, if mixed too thick, force is required to bring the crown or cap to position, and the thin edges of collars are liable to be sprung from the sides of the roots; neither will the cement adhere with such tenacity to the parts as when mixed to a proper consistence. If the slab is placed on a towel that has been saturated with ice water, the cold will retard the setting. In this respect the sides of a square glass bottle filled with cold tap or ice water, and well corked has its advantages as a mixing slab in hot weather. Fig. 485 is a bottle with a thermometer inserted to indicate the temperature.¹

In cementing a collar crown it is always preferable to have the

¹ Introduced by Dr. W. V. B. Ames.

cement mixed a trifle too thin rather than too thick. This should be borne in mind, as the adjustment of many a well-fitted crown is impaired by having the *cement mixed too thick*.

Application.—If the gum-margin has been slightly lacerated and is inclined to bleed, adrenalin or adrenalin and cocain should be applied for a few minutes. The parts to be crowned are then syringed with tepid water, protected by a napkin, bathed with alcohol applied on cotton with tweezers and dried with absorbent cotton or bibulous paper. In cases where the prepared teeth or roots have been exposed to the action of the secretions of the mouth for one or more days during the construction of the work, before its final insertion the surface of the tooth structure also should be thoroughly cleaned and sterilized. This is effectively done with fine pumice moistened with compound tincture of iodine diluted with peroxid of hydrogen, applied with a stick or brush

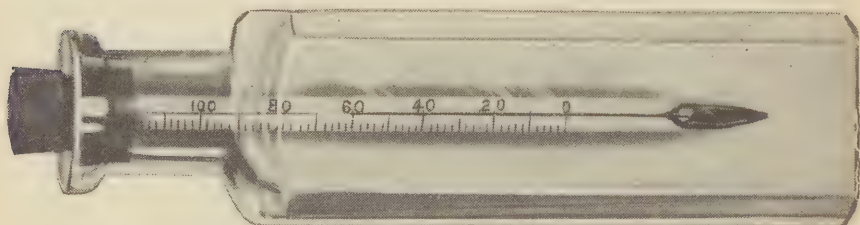


FIG. 485.

point over the entire surface of the tooth-structure and under the gingival margin. The iodine not only aids in cleansing and sterilizing the parts but also acts on the membrane of the gingiva as an astringent.

A rope of tightly twisted absorbent cotton may be wound around each crown to be capped and pressed close against the gum, with the ends twisted together at the labial side so that the cotton may be easily seized and instantly removed at the moment the cement is ready. The cotton can be retained in position over and around a root end by inserting a portion in the orifice of the canal. Collar crowns should have been previously inserted and given a final burnishing. Each cap or crown, having been thoroughly cleaned and dried, is filled with enough cement to insure a slight surplus. A small portion is then put in each root-canal or hollow part of a natural crown present, and the artificial crown or bridge immediately adjusted in position.

In most cases it is best to remove the napkin or absorbent cotton quickly and close the mouth to insure the occlusion of the teeth, and

then open the mouth and replace the napkin. The crown, or bridge, should be held under pressure until the cement has set. In setting bicuspid or molar crowns and in bridge-work, it is better in the majority of cases to occlude the teeth and keep them in position under a steady pressure until the cement sets. Under these circumstances, the saliva can reach only the surplus portion of the cement and cannot interfere with that under the cap or crown. One thickness of thin tin foil placed over the crown as the teeth are occluded will slightly increase the pressure.

When the cement has set perfectly hard, the surplus around the edges should be removed. In collar or cap crowns the extreme edges of the gold of the collar or cap should be given a final burnishing, but force against the side of a collar should be avoided, as tending to injure the cement under the collar. A fine-pointed instrument and floss silk should be passed between and around the teeth to remove any particle of the superfluous cement, and finally the parts should be syringed with tepid water. An application may be made of a saturated solution of aristol and oil of cloves with cotton twisted on the point of a probe to relieve pain and allay irritation.

The patient should be requested to call in a few days so that an examination may be made to see if any particles of the cement were overlooked. Cleansing at this time facilitates the healing of the gum around the edge of a collar. Care in such details tends to prevent an inflamed appearance and recession of the gum often seen around crowns, and also insures a satisfactory result to the patient and commendation to the dentist.

Gutta-Percha

The fact that recent improvements in cements have rendered them so dense and hard that crowns and bridges cemented with them are so difficult to remove that they are generally destroyed beyond replacement or repair, has prompted an endeavor in the use of gutta-percha alone or in combination with oxyphosphate or the silver chlorid cement.

Gutta-percha will allow the work to be removed generally intact, although after a time it does not soften as easily as when it was applied. Its lack of rigidity confines its use to crowns and bridges that rest steadily on their foundation and require the gutta-percha only as a medium of attachment. The slightest vibration of a cemented cap or crown on its foundation will more or less admit the permeation of agents which will result in the gradual infection of gutta-percha and consequent impairment of its attachment. Oxyphosphate combined

with gutta-percha may be utilized in many instances to overcome this difficulty.

One of the greatest objections to the use of gutta-percha is its refractory behavior in application, as it cannot be rendered more than semi-plastic with heat and accordingly is difficult to manipulate as a cement. Gutta-percha will adhere to a heated metallic surface but does not adhere proportionately as well to tooth structure.

The pink base-plate gutta-percha or gutta-percha of a similar character is the form most used to cement crowns and bridges. This form being generally accepted as the most suitable, similar preparations that can be more easily manipulated have been introduced.

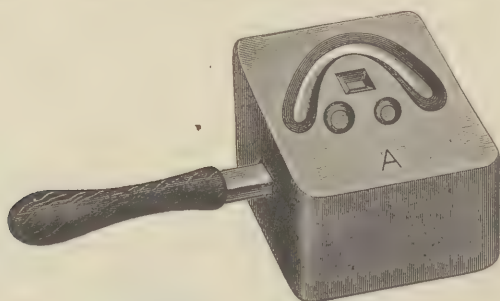


FIG. 486.

Method of Cementing with Gutta-Percha or Gutta-Percha Cement.

The description given will apply to both gutta-percha and gutta-percha cement, but the latter will be found much easier of manipulation.

First. Clean perfectly each post and the inside of each cap.

Second: Place the cement-heater (Fig. 486) on a support over a Bunsen flame, remove the handle, and heat until a drop of water placed on the surface will instantly boil and be evaporated. Insert the handle, remove the cement heater and place it on a small asbestos pad, or a couple of instruments laid upon a table, and again remove the handle; or use a How gutta-percha heater (Fig. 487).

Third. Place the crown or bridge in a slot in the cement heater, or on the surface of the How gutta-percha heater. Heat a spatula (Fig. 488 in miniature) and place the requisite amount of gutta-percha on the gutta-percha cement heater (A Fig. 486) or on the central section of the How gutta-percha heater. If gutta-percha cement is used, manipulate it with a hot spatula and it will immediately assume a plastic consistence. To apply either the gutta-percha or the cement, steady the crown or bridge with tweezers on the slab or in the slot,

of the cement heater, or remove and hold in a napkin with the fingers. Reheat when necessary and return it to the heater when the gutta-percha has been applied.

The gutta-percha or cement should be applied with the hot spatula a very little at a time, as a surplus will not press out like oxyphosphate. In the case of collar crowns the proper and simplest method is to first measure the amount of gutta-percha or cement required.

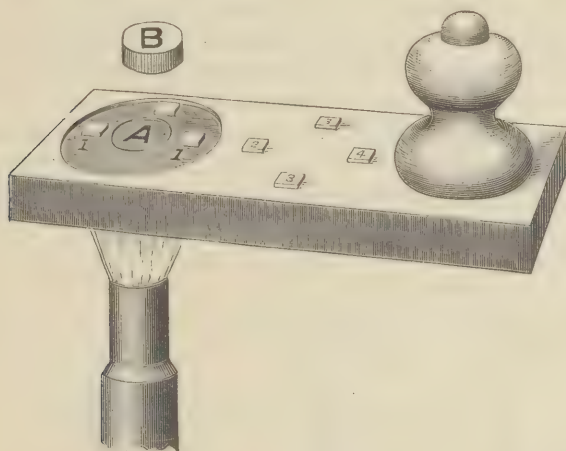


FIG. 487.



FIG. 488.

Method of Measuring Gutta-Percha.—This is easily done by first placing a little of the gutta-percha or cement on the sides of the interior of the collar of a cap or of a gold crown, as shown in section at A, A, Fig. 489, adjusting the work in exact position in the mouth on the wet natural teeth by pressure and occlusion of the antagonizing teeth, and then instantly removing. The saliva on the teeth will prevent adhesion of the gutta-percha. The surplus on the sides will be pushed to the bottom of the cap and when the cap is removed will show the impression of the natural tooth, as illustrated in Fig. 490. Any vacancy at the point B in the bottom of the cap will very accurately indicate the deficiency. Next wash the saliva out of the cap with a syringe full of water, rinse with alcohol by pouring in a few drops, and place the work on the heater and wait until the alcohol has evaporated, then apply the required additional gutta-percha or cement. A small straight, blunt-pointed instrument—such as a broken excavator—is useful to carry small pieces or pellets to the bottom or corner of a cap.

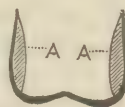


FIG. 489.

To distribute the gutta-percha or cement in the case of a Richmond crown, place a little on the inner edge of the collar as indicated at S, S, Fig. 491. By one or more insertions, the necessary quantity for the remainder of the surface of the crown can be accurately determined. Next and last apply the gutta-percha on the post. Should any vacuoles exist they will be filled by the film of oxyphosphate applied to the surface of the crown or bridge abutments in the final act of cementation.

In any form of crown with a closely-fitting post without a collar, first measure the quantity of cement required at the base or floor, by placing the gutta-percha or cement on that part, inserting the crown in the mouth and removing before applying to the post.

To Apply Gutta-Percha in the Form of a Film over a Surface.—Place a little of the gutta-percha or cement in the concavity formed in the bottom of a cup or jar, add chloroform, mix with a camel's-

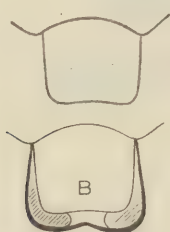


FIG. 490.

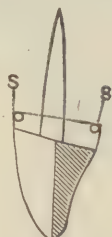


FIG. 491.



FIG. 492.

hair brush and apply the solution evenly over each post and on the inner surface of each metallic cap. Next place the crown or bridge in the slot of the cement heater to evaporate the chloroform.

As only a very small quantity of gutta-percha will intervene between a close-fitting post or metallic cap and the tooth structure, the adjustment is more easily effected in the mouth when the cement is evenly placed over the surface as described.

The best possible adhesion of gutta-percha to metal is secured by slightly scratching intersecting lines on the posts and inner surface of metallic crowns, in the form shown in Fig. 492, with a fine sharp-pointed instrument previous to the process of cementation. In open-faced crowns when a strip of the metal traverses the cervical section of the labial face this process applied to the inner surface of the strip very materially aids in the retention of the gutta-percha.

When the gutta-percha or cement has been measured, the crown or bridge is left on the cement-heater until ready to be cemented in the mouth.

Gutta-percha does not adhere to tooth-structure as well as to metal. For permanent insertion to secure a reliable adhesion of the gutta-percha, varnish the root or tooth with a very thin film of oxyphosphate or the silver chlorid cement. This is best done by mixing a portion of the cement to the consistence of a *very thin cream* and applying it with a small stiff camel's-hair brush *on the sides* of the crown or root. As the cap or caps are brought to position the pressure will be sufficient to make the cement adhere securely to the tooth-structure and the gutta-percha. The cement also excludes air by creating a slight surplus.

To Cement the Crown or Bridge.—Syringe the tooth or teeth to be crowned with water, protect from saliva, bathe with alcohol applied with a pellet of cotton, dry and evaporate all moisture with a hot-air syringe. After the gutta-percha has been applied to the crown then mix the cement and apply it quickly as described, then immediately remove the crown or bridge from the heater, and when it has cooled to a point that will permit it to be held between the fingers, instantly place and press it to position in the mouth, and in the case of a gold crown or bridge have the patient forcibly occlude the teeth and hold them firmly in position until the oxyphosphate cement has set. When the gutta-percha has become cold and hard the surplus oxyphosphate at the edge can be removed.

For Temporary Insertion.—Instead of using oxyphosphate as described, varnish the root or tooth with a thin coating of chloro-gutta-percha or in the use of gutta-percha cement, with the adhesive fluid that comes with it. The gutta-percha can be chilled with cold water from a syringe. It is hardened to a certain extent by the application of cold but does not acquire its greatest density for some time.

Requirements for Success.—For the successful use of gutta-percha, crown- and bridge-work must be constructed with that intention, and every detail connected with the cementation carefully carried out. Richmond crowns should have long substantial posts, either round or of the Logan pattern, properly fitted to the canal (Fig. 493). If the canal is enlarged from some cause or is of irregular form, after closing the foramen with gutta-percha, taper the end of the post and fit the point deeply in the canal, varnish the post all over with a film of chloro-percha, evaporate the chloroform, fill the canal with oxyphosphate and insert the post. When the oxyphosphate has set, heat the post or crown, withdraw it, and wipe out the canal with a wisp of cotton saturated with chloroform to remove the gutta-percha adhering to the oxyphosphate. This furnishes a close-fitting socket for the



FIG. 493.

post. For all-gold crowns, badly decayed teeth should have their sides restored with amalgam or gold inlays. Roots for gold crowns should have posts or screws cemented in them and be shaped up with amalgam, as shown in Figs. 182 and 183. Short gold crowns supporting bridge-work require one or two pins that will fit in small holes drilled in the deep fissure of the occlusal surface, as shown in Fig. 494, or in a slot or cavity in the side extending nearly to the cervical margin as illustrated in Fig. 495. A pin, no matter how short, inserted in the center of the occlusal surface of an all-gold crown steadies the crown

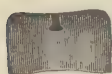


FIG. 494.

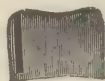


FIG. 495.

and thus assists in its retention. Rolling wire under the flat side of a file before using in the construction will roughen it and offer a better surface.

Favored by proper construction, many cases of bridge-work can be reliably cemented with gutta-percha. Among the exceptions are very short caps or open-faced crowns in which pins or a post cannot well be inserted and which in supporting bridge-work are subjected to a great strain or pressure in occlusion; also *all cases of extension bridge-work*.

Oxyphosphate in Combination with Gutta-Percha or Gutta-Percha Cement.—Gutta-percha or gutta-percha cement may be used in combination with zinc oxyphosphate by applying the gutta-percha scantily over the cavo-surface of the cap and removing the gutta-percha from the entire cavo-edge or border and in the final insertion of the work, coating the surface of the natural crowns or roots with oxyphosphate applied in sufficient quantity with a small brush to fill all vacancies and then immediately inserting the crown. This method will result in the presence of a coating of oxyphosphate over the surface of the tooth or root and a larger proportion of gutta-percha over the cavo-surface of the cap. It will increase the security of attachment and the gutta-percha, which simplify removal. (For the removal of crowns and bridges cemented with gutta-percha, see page 344.)

Silicate Cement.—This cement in an improved form is commencing to take the place of oxyphosphate of zinc for cementation of porcelain inlays, as it closely resembles porcelain and is less soluble than the oxyphosphate. It is, though, not as adhesive as the latter.

Amalgam.—The use of amalgam for purposes of cementation has been superseded by the oxyphosphate, silver chlorid and silicate cements.

PART IV.
BRIDGE-WORK

INTRODUCTION

Scientific Mechanical Principles

A bridge is a structure that spans a space and is supported by solid bases termed abutments and piers. The abutments are located at each end of the structure and the piers at intervals between the abutments. A bridge is designed to support not only its own weight but additionally such pressure and stress as its structural capacity is calculated to bear.

A bridge consists of a substructure and a superstructure. The substructure consists of the foundations and the superstructure of the portion that rests on the foundations and spans the space.

Bridges are classified as of five forms; Arch bridges, in which the pressure is vertical and outward against the terminal abutments; Truss bridges, in which one girder or several connected girders form a rigid span between the abutments; Suspension bridges, in which platforms are supported by cables that pass over abutment-towers, the ends of the cables being anchored in the ground; Pontoon bridges, formed of platforms resting on boats anchored in a stream; Cantilever bridges, formed of two trusses, the central section of each truss resting on a pier, with the longer ends of the trusses weighted and anchored in the shore, and the shorter or river ends extended so they meet.

Dental Bridge-work

In dental prosthesis bridge-work is the utilization of natural teeth or roots as the substructure-abutments and of artificial teeth as the superstructure-spans.

Antiquity.—The artificial repair of the loss of a portion of the teeth by bridging the vacant spaces with substitutes, supported in position by means of their attachment to adjoining or intervening natural teeth, is, as we have seen in the introduction, of ancient origin, having been practiced long before plates came into use.

Primitive Methods.—Originally the application and mechanical construction of such dentures was of a most primitive character, and as the attachments were simply ligatures, or clasps of gold, the teeth were

more ornamental than useful. Figs. 496, 497 and 498 illustrate some antique methods.¹ Fig. 496 is an illustration of a specimen of ancient Phoenician dentistry. Fig. 497 is that of one of the Etruscan age, dating about 500 B. C. Fig. 498 gives a view of the same denture inverted.

Dentures constructed on the bridging plan by various methods have been occasionally employed from the earliest days of modern



FIG. 496.



FIG. 497.

dentistry, although until recent years the method has not obtained general recognition or been extensively practiced as a system.

Modern Literature.—Dental literature presents bridging operations as described by Dubois de Chemant in 1802; J. B. Gariot in 1805; C. F. De la Barre in 1820; Dr. S. S. Fitch in 1829; William Imrie in 1834; J. Patterson Clark in 1836 (Fig. 499) and Dr. W. H. Dwinelle in 1856. Figs. 500 and 501 are copies of illustrations in Dr. Fitch's



FIG. 498.

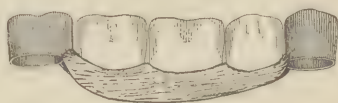


FIG. 499.

work, published in New York in 1829, and Fig. 502, one from a translation of F. Maury's work in 1843. In 1871 the bridging process or bridge principle was again brought to notice by a patent applied for in England by Dr. B. J. Bing, of Paris, for an improved means of supporting and securing a bridge by anchoring with cement or fillings, clasps or bars, extending from it into holes formed in the adjoining teeth (Fig. 503). The system was also practiced by the late Dr. M. H. Webb and is described in his "Notes on Operative Dentistry."

¹ See "Independent Practitioner," Vols. VI and VII, "Evidences of Prehistoric Dentistry," by J. G. Van Marter, D. D. S., Rome, Italy. Figs. 496, 497 and 498 are copies of the illustrations of specimens, the first of which is represented as being in the museum of the Louvre, Paris, France, and the second in the Corneto Museum, Corneto, Italy.

Modern Methods.—The facilities afforded by the artificial crown-work now in vogue for supporting and securing bridge dentures have caused a revival of the system in an improved form, now termed “Bridge-Work,” in which artificial crowns cemented to natural teeth or roots are employed as abutments to support artificial teeth which span or bridge the space between them. These bridges are so devised in the best

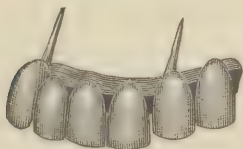


FIG. 500.



FIG. 501.

methods that, while supplying the patient with the means of masticating food, the cleanliness of the denture is also provided for.

Advantages.—Ordinarily bridge-work is immovably cemented in position. The claims set up in its favor are as follows:

First.—The perfect replacement of lost teeth by artificial substitutes without the use of a plate.

Second.—The absence of any mechanical contrivance to interfere with the tongue in articulation.



FIG. 502.

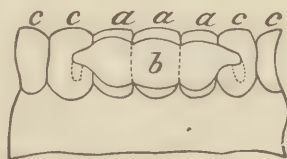


FIG. 503.

Third.—The functions of the sense of taste are more perfectly performed and a healthy condition of the tissues preserved because the gums and palate are not covered over with a plate.

Fourth.—The solidity and security of the denture at all times, both in speech and mastication.

Fifth.—The weight of the denture and the strain of mastication are proportionately distributed over the natural teeth, which are better suited to sustain them than the contiguous alveolar surfaces.

Sixth.—Its special adaptation to the replacement of single teeth or of a small number of teeth, where bridge-work is usually superior to any other device.

Seventh.—While all operations performed for the restoration of lost teeth, like other remedial operations, are temporary rather than permanent in their results, bridge-work as regards permanency takes equal rank with any other operative procedure.

Objectionable Features.—The following, on the other hand, are the objections raised, particularly so against cemented unremovable bridge-work as generally constructed.

First.—It fails to restore the contour of the soft tissues above the bridge, as in cemented bridges artificial gums cannot properly be used.

Second.—The slots under the artificial teeth fill with particles of food.

Third.—The speech and comfort of the wearer are often affected by these slots, especially when under the front teeth.

Fourth.—The natural teeth employed as abutments are permanently mutilated by the process of crowning.

Fifth.—An extensive bridge made of gold, when immovable, cannot possibly be kept perfectly clean, as the metal will gradually tarnish in parts out of reach of the brush and foreign matter will gather on its surface and in its interstices and become septic.

Sixth.—In cases where it becomes necessary to temporarily remove a cemented bridge for the purpose of repair, or when some pathological condition suggests or requires it, the operation is difficult and the bridge is usually injured so as to unfit it for reinsertion.

Seventh.—The teeth that support a bridge, whether fixed or removable, are required to bear more force and pressure than nature intended—where the piece is large, many times more—and at no time can rest be given the abutments or the contiguous parts. Thus, in a piece of bridge-work of fourteen teeth supported by attachments or crowns on four to six natural teeth, each one of the natural teeth may have to bear two or more times the strain in supporting the weight of of the denture and the force of mastication than was intended. The abutments and piers are deprived of the power to respond to vibratory as well as masticatory force. The ultimate result is evident to anyone who is experienced in dental practice, and unless the anatomical conditions are most favorable, the usefulness and durability of such work is liable to be limited in character, considering the time, trouble and great expense attending its construction.

Prophylaxis.—The most forcibly urged objection advanced against fixed bridge-work is that it is uncleanly and that a septic condition supervenes which in time becomes infectious.

Small bridges comprising only a few teeth are much less open to this criticism than large ones. The proposition depends principally on

judgment respecting the suitability of a case for bridge-work, the form of bridge applied, and the skill employed in its constructive details, especially the continuity of all its parts.

In properly applied and constructed bridge-work, uncleanness is usually attributable to lack of knowledge on the part of the patient of proper methods of prophylaxis, or neglect.

Consequently, the tendency is to confine the application of bridge-work to favorably positioned small cases and to make large ones removable.

Such are the arguments that have been put forth for and against bridge-work; and yet, whatever may be urged against it, its advantages are recognized by a majority of the profession, including accepted authorities, some practitioners even going so far as to proclaim it the only true method for the insertion of partial dentures.

Impartial Consideration.—Judged impartially, bridge-work has many advantages when practiced by experts who properly construct and apply it. Without doubt it has been, and is still, and will be abused. Bridges have been inserted where the support was insufficient or the construction was wrong in principle or faulty from lack of skill. Moreover, bridge-work is even yet still passing through the experimental period when failures are apt to appear more prominently than successes. The chronicles of dental literature, however, offer in this respect only a repetition of the historical difficulties that attend all new methods in the arts.

Forms of Bridge Construction

Bridge-work is constructed either Fixed, Detachable or Removable. A fixed bridge is permanently cemented; a detachable bridge can be detached by the dentist, and a removable bridge by the patient. Of these three forms of bridges there are several subdivisions differing in application, details of construction and materials, each of which will be separately discussed in the next and the succeeding sections.

CHAPTER I

CONSTRUCTION OF BRIDGE-WORK

To those who are properly informed in mechanical dentistry and versed in metal and crown-work, bridge-work does not present extreme difficulty. The foundations or abutments, that is, the teeth or roots on which the bridge will rest, are first to be considered, due respect being paid to the mechanical principles controlling the leverage and the force of occlusion in mastication.

Principles Involved

The proper selection of abutments, and the type and form of construction of bridge-work are fundamentally dependent on a knowledge of and application of the principles of the sciences of anatomy, physiology, orthodontia, metallurgy and mechanics, oral surgery and hygiene. Failure to comply with the principles and requirements of these sciences will invariably partially if not entirely destroy the functional efficiency and permanency of the operation, and establish conditions detrimental to the health of the patient.

Abutments, Retaining and Supporting

The abutments in cemented bridge-work are divided into two classes, retaining and supporting. A retaining abutment retains as well as supports a bridge. A supporting abutment supports a bridge but does not retain it in position.

Mechanics

In the selection of abutments the amount of stress that can be borne by the different teeth, individually and collectively, according to their position and condition of health, should be carefully calculated. A relative estimate of the ability of different teeth to resist stress when used as abutments would place them in the following order:

(a) First Molars, (b) Second Molars, (c) Cuspids, (d) Bicuspid, (e) Central Incisors (d) Lateral Incisors.

In dental bridge-work the stress on the abutments is both direct and lateral, divided proportionately according to their position and the character of the occlusion. As a rule the force upon the incisors and cuspids in occlusion will be directed outward on the upper and inward on the lower. Therefore the tendency, when any of these teeth or roots support a bridge, is to gradually press them and the bridge out of line in these directions.

In the case of molars the force is mostly direct in an apical direction in a normal occlusion, with some lateral pressure caused by contact of the cusps in the movement of the mandible in mastication.

Occlusion

In the planning of bridge-work there is no other factor on which the future success of the bridge as a serviceable and lasting denture depends so much as a properly arranged occlusion. Pressure on abutment and pier teeth should be placed as nearly as possible in line with the axes of their crowns and roots, and occlusal surfaces of both abutment and pier crowns and pontics should be positioned and shaped with this object in view. The greater the proportion of the vertical stress to that of the antero-posterior or lateral, the greater the probability that two or more abutments and piers combined will be able to withstand the stress placed upon them in occlusion and mastication, and the longer is the term of their usefulness assured.

In the construction of bridge-work the occlusal surfaces of abutments should be given normal dimensions, but the cusps should be so shaped as to minimize stress in mastication in the lateral movements of the mandible when brought into contact with the cusps of antagonizing teeth. Short cusps cause less lateral stress than long ones. This point should be borne in mind, not only in relation to the occlusal cusps of abutment crowns, but especially in regard to those of pontics, the occlusal surfaces of which should be additionally favored by being made slightly narrower bucco-lingually than the abutments and very narrow when there are no antagonizing teeth.

A normal line of occlusion of the teeth favors the construction and use of bridge-work. When such a condition does not exist, the defect should be remedied as much as possible by trimming the incisal edges and occlusal surfaces of such antagonizing teeth as are out of line and restoring as far as may be the line of the occlusal plane.

Procedure under such conditions is illustrated in Fig. 504, a case in which the occlusion is not uniform. The dotted line indicates how much of the teeth requires to be removed to remedy the defect and

render the occlusion favorable to the insertion of bridge-work that will permit proper performance of the masticatory function. Sometimes the removal of a pulp may become necessary in order to effectually shorten a tooth which has become excessively elongated.

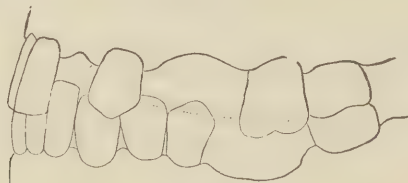


FIG. 504.

The Artistic and Esthetic

In dental prosthesis bridge-work does not always enable the operator to improve the appearance of the patient as well as it can be done with plate-work. The teeth or roots present that have to be utilized as abutments may not be in normal position or occlusion and the labial surfaces of teeth used as abutments with inlay attachments or open-face crowns, may be more or less disfigured by erosion or abrasion. Deep depressions caused by absorption of the alveoli cannot be entirely concealed with fixed bridge-work, as the utilization for the purpose of metal or vulcanite and even porcelain, except to a very small extent, would not be sanitary. Such restoration demands the use of a removable bridge or a plate. These conditions, also that of abnormally large or small spaces requiring to be filled with only a certain number of artificial teeth, tax the ingenuity and mechanical skill of the operator. Correct arrangement and harmony of form should prevail wherever possible.

Porcelain Facings and Teeth for Pontics

Facings and teeth should be selected that in form and shade will not appear artificial in contrast with adjoining natural teeth. A display of gold, especially in connection with the eight anterior teeth, should be avoided wherever possible. The truly artistic and esthetic demand a restorative operation that will pass unnoticed to an observer.

Classification of bridge-work

A simple bridge is unilaterally straight in alignment, or nearly so, and supports but one or two teeth or pontics.

A *compound bridge* is unilaterally curved in alignment, is supported by end abutments and intervening piers, and replaces from three to five teeth.

A *complex bridge* is bilaterally curved, crossing the median line, having the necessary abutments and intervening piers. It replaces from four to ten teeth.

Under normal conditions the rules that generally govern the number and position of the teeth or roots required as foundations for bridges are as follows:

One central crown or root as a retaining abutment will support the adjoining central with the aid of a lug resting on or anchored in an inlay or filling in the lateral as a supporting abutment. A cuspid will support a central and lateral with retaining abutment on the other central.

Two central crowns will support the laterals with the aid of supporting abutments in the cuspids.

The cuspids alone will support the incisors, but preferably so with aid from a central incisor as a pier, or inlays of lugs in the bicuspid, termed a simple bridge.

One molar or bicuspid on one side and a bicuspid or molar on the other, and two reliable piers in an intermediate position, will support a bridge between them, termed a compound bridge.

One first or second molar on one side and one molar on the other with the assistance of the two cuspids, will support a bridge comprising the arch between them; termed a complex bridge.

Two or three suitable teeth or roots on one side of the mouth can support between them a bridge on that side. The cuspids always afford a reliable anterior support.

In a cuspid anterior bridge, such as is shown in Fig. 505, its outward curve, especially when the articulation of the antagonizing teeth is close and deep, causes lateral stress or leverage in excessive proportion to the direct. Such a dental bridge in form is equivalent to a curved truss bridge, which in principle would be condemned as contrary to engineering principles unless supported by at least one centrally located pier to relieve the lateral stress on its terminal abutments.

In the case of a cuspid anterior bridge, a centrally located pier not being available, the bridge should be made removable, with a saddle as a substitute; or the cantilever principle should be employed by obtaining support distally from the bicuspid. Such support may be obtained for this bridge, as for other differently located bridges, in a variety of ways, the character or form of device to be determined by the conditions and requirements of each case.

In the case illustrated in Fig. 505, when the adjoining first bicuspid has a vital pulp, either a partial or an entire gold cap-crown can be placed upon it, as shown at CB, Fig. 506, or a mesial occlusal inlay may be inserted, extended across the occlusal surface with the distal end additionally secured with a post, as shown at D. Another method is to insert a triangular bar with the end bent and extended as seen at E. A pulpless tooth admits of a deep extension of the post into the pulp-chamber.

In the case of a cuspid anterior cantilever bridge and in all cases where either inlays or crowns are joined together as abutments, the construction should be so conducted as to leave the interproximal *spaces open and free to insure the presence of the gum septa in a normal con-*

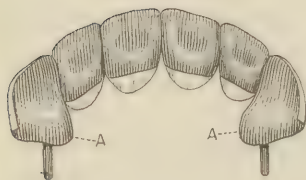


FIG. 505.

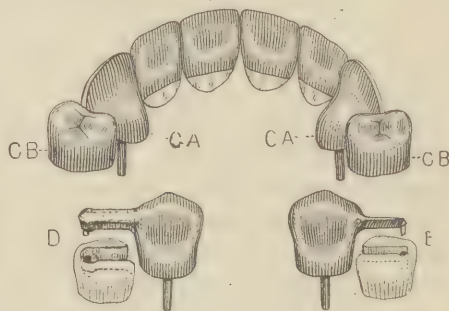


FIG. 506.

dition. In a compound cuspid anterior and second bicuspid bridge, the four incisors and two first bicuspid being replaced, the second bicuspid abutment crowns act as cantilever supports and usually are reliable anchorages. In a cuspid posterior second molar bridge carrying the two bicuspid and the first molar, the cuspid and second molar have to withstand the force of the occlusion of five teeth and the cuspid lateral stress in addition. Such a bridge is best made of the removable saddle type, as in the fixed form the abutments in a short time will become impaired. In all cases where there is an extensive span between the abutments, a removable saddle bridge-piece is the most suitable form to construct, as the saddle will materially control lateral pressure.

The rules given, applied to these cases, will enable the operator, governed by the special conditions presented in each individual case, to properly select and decide the character of the abutments and piers. The relative resistance of individual teeth and the conditions respecting occlusion are here given as a general guide, but several contributing factors may upset any plan which affords no scientific basis for comparison.

Selection of the most suitable teeth as abutments or piers in bridge-work operations so as to most effectively distribute the force of occlusion, will assure the best practical results, especially as regards the maintenance and stability of the abutments, on which depends the durability of the work.

Preparation of the Supporting Teeth or Abutments.—The preparation of teeth or roots to support a bridge is the same as for ordinary crowns, except that the trimming of the sides and the reaming of the root-canals of the various anchorages must be in parallel lines, so that the collars and posts of the crowns will move readily to their places in the adjustment of the finished bridge. Teeth or roots which are to be supplied with porcelain-faced or all-gold cap-crowns are crowned by some of the methods already described. In the first stage of the con-



FIG. 507.

struction of the bridge, the roots that are to carry porcelain-faced crowns may be only capped, the posts being soldered and allowed to project a short distance beyond the caps.

The lines of the crowns of teeth or root-canals to be used as abutments or supports for bridge-work are seldom exactly parallel. This fact should be borne in mind and receive proper consideration in their preparation. When one of the intended bridge-supporting teeth tips, or when two of them lean toward each other, the tipping side or sides may require extensive trimming, while the other side or sides will usually require much less. This is finely exemplified in Fig. 507, which represents a molar and cuspid with vital pulps. The cuspid in tipping forward has straightened the line of the posterior or distal side, so that it requires very little trimming. The portion requiring removal at the point A, will be regulated to some extent by the shape given the molar. By considerable reduction of the distal side of the molar at the point B to a line parallel with the anterior or mesial side of the cuspid, a form is given to both teeth which, with a moderate reduction of the anterior or mesial side of the molar and proper shaping of the other sides, will permit the removal and insertion of the caps in the construction, and ready adjustment at the cervical section when permanently inserted.

It is not essential that the parallel lines of the sides of prepared teeth or roots shall form a right angle to a straight line between the cervices of the abutment teeth or the space between them. Teeth or roots may slightly converge in the occlusal direction, but they must not diverge.

The application of this principle to the preparation of a lower molar and bicuspid for an intervening bridge is shown in Fig. 508, which is typical of cases frequently presented. Here straightening of the posterior or distal side of the bicuspid and removal of a portion of the anterior or mesial side of the molar, as indicated by lines, will considerably aid in obtaining a form that will permit of correct adjustment of the caps.

This principle is further exemplified in Fig. 509, where the inferior cuspid and the lateral incisor are used to support a bridge.



FIG. 508.

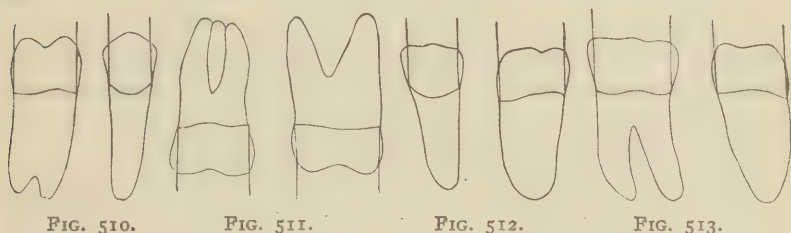
FIG. 509.

The presence of decay on the side of a tooth requiring the most shaping, facilitates the operation, as chisels and cross-cut burs may be used to assist in removing the main portion of the bulging enamel. The cavity should be excavated and filled with a cement, or preferably amalgam, previous to the final shaping.

Plain thin carborundum disks will remove the approximal surface towards the adjoining tooth more rapidly than those of vulcarbo, but they must be used with greater precision to avoid their fracture. Commence with a disk of moderate circumference and follow with larger sizes. Removal or mutilation of the contour of an adjoining tooth must be avoided. Frequently the formation of a space can be advantageously commenced with a thin safe-sided separating file, then increased with paper carborundum-disks. These may be followed with a regular disk. Small, moderately thick carborundum wheels or disks, whose circumference has been considerably reduced by use, may be advantageously employed on the sides of the teeth approximal to the space to be bridged. The reduction of the labial and lingual sides must be such as will give a form that will permit the edge of the collar of the crowns to slide over the coronal section, and assume the proper position under the gingival margin. The occlusal surfaces of teeth should be

removed sufficiently to permit the presence of an intervening surface of metal capable of resisting attrition. The proper thickness of the metal for this purpose is regulated by the character of the occlusion. The hardness of the metal to be used for forming the occlusal surfaces, whether it is a gold alloyed with copper and platinum, or largely with copper only, in contrast to the gold plate used to form the sides of the crown, may also be considered in calculating its resisting power.

The reduction of normal teeth to be used as abutments in bridge-work to an actual thimble-shaped form is not necessary, as such reduction would demand in many cases the extirpation of the pulp, the



vitality of which might be preserved by the adoption of less extreme trimming. The removal of contour and enough tooth-structure to parallel the sides so as to permit the edge of the collar of a gold cap to fit perfectly at the cervical section, just under the free margin of the gingiva, is sufficient. To pass deeper than this point will usually demand considerably more reduction of the coronal section. Figs. 510, 511, 512 and 513 illustrate upper and lower bicuspid and molars of normal form. The lines indicate the amount of tooth structure usually necessary to remove from such teeth when the pulps are vital.

The proportion of bulging constituting the contour of teeth varies considerably. Short bicuspid and molars demand less shaping to prepare them for the reception of caps than longer teeth. The lingual sides of lower bicuspid and molars require much more to be removed than the buccal. Second and third molars free of decay when the gingival margin covers the coronal section considerably, seldom require extensive shaping.

In sound bicuspid and molars with the crown fully exposed and slight recession of the gingiva; also in teeth with small necks and large contour, a reduction of their form sufficient to permit proper adjustment of the collar of the metallic cap at the cervix usually demands pulp extirpation. In the present state of the art, the vitality of the pulp of

the tooth is preferably preserved by the use of an inlay or partial cap attachment instead of a collar crown. (See pages 311 to 319.)

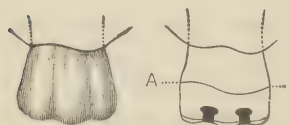


FIG. 514.—A, A, is the line to which the enamel is removed, leaving a slight shoulder for the edge of the gold cap.

A secure anchorage to vital molars and bicuspid, especially those in the mandible, is easily obtained by reducing the sides and occlusal surfaces sufficiently to allow the formation of a cast or swaged cap that will only partly cover the coronal section, and fit at the margins of the portion removed, as shown in Fig. 514. One, two or three pins may be inserted in the cap for security.

Fig. 515 shows another method of shaping a molar tooth for a cap of this style. It requires a greater removal of tooth structure than that shown in Fig. 514. Mesial-occlusal-distal-lingual and mesial-occlusal-distal attachments may also be utilized. (See pages 313 to 318.)

In a case where a molar tips in the manner shown in Fig. 516, the most advisable plan is to either insert an inlay in the occlusal surface that can be inserted in the same line as the bicuspid cap; or to crown the molar and place at the mesial side a lug or attachment for the distal end of the bridge. (See pages 295, 317, 318, 319, 329, 330, and 354.)

The presence of decay with extensive calcification of the pulp in a tooth will admit of the removal without pulp extirpation of more enamel and dentin than if it were perfectly normal.

When teeth are pulpless, shaping always can be more freely practiced. In such cases the collar should be carried well under the gingival margin as a protection for the devitalized dentin against decay, but



FIG. 515.

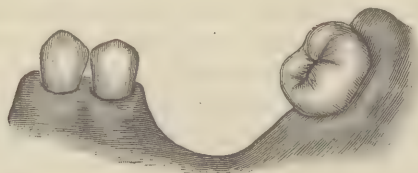


FIG. 516.

not to impinge on the pericementum, and the occlusal surface may be more extensively removed. Extreme reduction of the coronal section of a tooth does not always facilitate the work of construction, but often the reverse, as straight or slightly tapering sides and the presence of a

reasonable proportion of the dentin will steady the collar during the formation of the cusp-cap. It will also assist in retention of the cap in correct position in the mouth for the construction of the bridge-work.

In the preparation of the anterior teeth for post crowns with porcelain facings, the canal, when necessary, may be reamed a little to one side at the orifice and the post of the crown correspondingly tapered on that side to favor its insertion and removal from the canal.

As to whether an incisor or cuspid should be entirely capped with gold, or a method be adopted by which the metal will be only slightly exposed or entirely invisible, in preference to excising the crown and inserting on the root a cap with porcelain facing, is a question to be determined by the conditions and circumstances attending the case. The position and occlusion of a tooth, its shape and general appearance, whether it is sound, free from decay, or partially or extensively decayed; whether the pulp is living or almost entirely calcified or has already been devitalized; also the age and sex of the patient, are conditions which should influence the operator in the adoption of the form of construction. The illustrations in the succeeding chapters on bridge-work show numerous methods which may be practiced.

Construction

The operative procedure as generally practiced in construction of all bridge-work is classified as follows:

First. Take two impressions and two articulating impressions, termed "bites," of the case when presented before operating on it, and make models and articulating models, one set to use as a study and reference model, and the other as a preparatory model for outlining and indicating the forms to which the teeth require to be trimmed.¹

Second. Prepare the abutment roots or teeth.

Third. Make the abutment caps, crowns or attachments.

Fourth. Take a "bite" and impression with the crowns or attachments in position. When a "bite" is taken separately or additionally to the impression, *the "bite" should always be taken first.*

Fifth. Make a model and articulating model.

Sixth. Select the porcelain facings for the pontics between the abutments and grind and fit them to position in accordance with the occlusion of the articulating teeth. Cover the labial facings with a plaster matrix.

¹ A study model is valuable to refer to during the work and especially so in case of subsequent discussion with the patient over operations performed.

Seventh. Apply metallic backings to the porcelain facings and additionally, incisal backings to the incisors and cuspsids and occlusal cusps to the bicuspsids and molars.

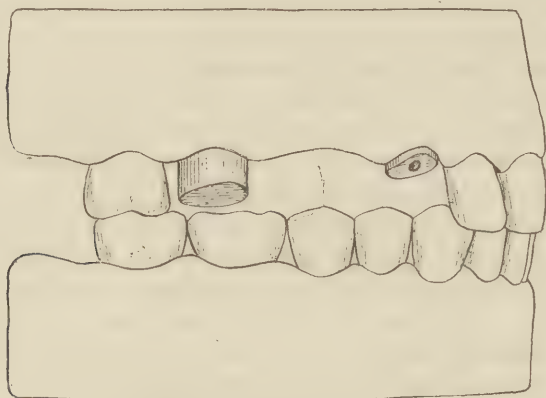


FIG. 517.

Eighth. Cement pontics and crowns together with adhesive wax on model, remove, invest and join together with solder; trim and polish.

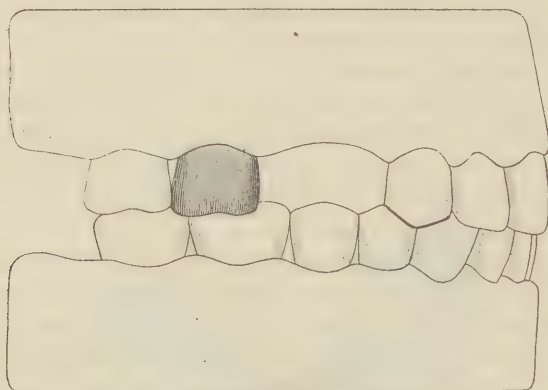


FIG. 518.

The case represented in Fig. 517 will be used to illustrate and explain constructive details. The abutments consist of the right cuspid root and the first molar, both of which have been prepared in parallel lines. A gold collar crown with porcelain facing (Richmond) is made for the

cuspid and an all-gold crown constructed in sections for the molar (Fig. 518).

Impressions and Models.—With the crowns in position in the mouth, an impression of the case and of the occluding teeth is taken with plaster slightly colored with carmine, to which may be added, if the plaster is slow-setting, a little potassium sulfate, less in proportion than salt, to cause it to set quickly. The plaster is mixed moderately thick and either rolled in a mass between the fingers, which should be wet to prevent adhesion of the plaster, or with the aid of a spoon it is placed around in the mouth on the crowns and parts to be included in the bridge, and the antagonizing teeth occluded tightly and so held,



FIG. 519.

until the plaster sets (Fig. 519). The mouth is then opened and the plaster carefully removed. Should the plaster break, the pieces are adjusted together and cemented with hard wax. The crowns are generally removed in the impression; if not, they should be transferred to it from the mouth.

The inside of the molar crown and the cuspid cap, also the post, are thinly veneered with paraffin to obliterate recesses, and later permit their removal from the plaster model. (See Part I, Chapter IV). The entire impression is varnished, then oiled and a plaster or preferably an artificial stone model first run in the upper impression carrying the crowns. When the model has become well set, it is mounted with plaster on an articulator—anatomical type preferred; next, the other side of the plaster impression, giving the articulation, is run—preferably with artificial stone instead of plaster—and the opposite section of the articulator adjusted and attached to the artificial stone with plaster.

When the impression plaster is removed (an operation which is facilitated by its having been colored with carmine), a correct model and articulation of the case will be found, with the crowns and caps in exact position as they were in the mouth (Fig. 520).

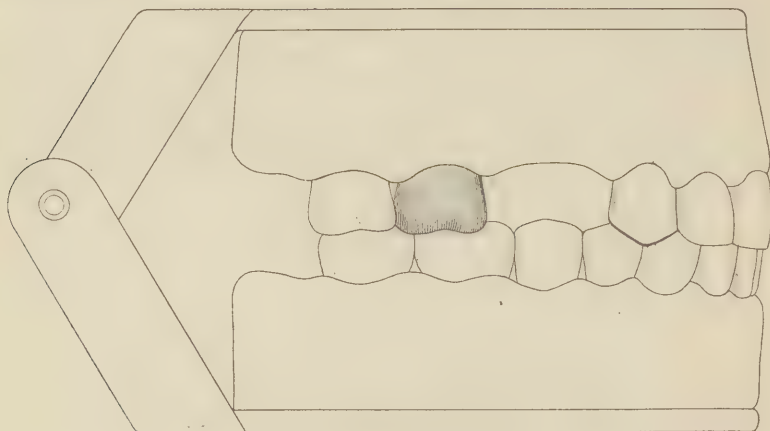


FIG. 520.

Danger of fracture of the form of the occluding teeth of the articulating model or "bite," in their removal from the plaster impression may be avoided by giving them the shapes illustrated in Figs. 521 and 522. This is done by trimming and shaping the mold of the teeth in the plaster impression at the lingual side to form C and C, and thoroughly varnishing and oiling before running the plaster. The shape given in no respect impairs their form for the articulating work.

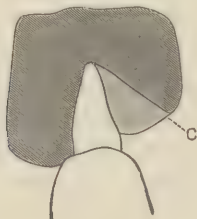


FIG. 521.

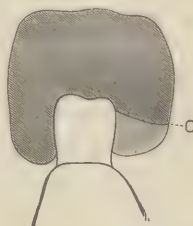


FIG. 522.

Selection and Adjustment of Artificial Teeth.—In bridge-work, cross-pin flat-back plate teeth, now known as porcelain facings or veneers, are used for incisors and cuspids, and partial teeth, represent-

ing the buccal section of the teeth and also termed porcelain facings—especially designed for crown and bridge-work—are used for bicuspid and molars (Fig. 523). Cuspids are sometimes used to form the facings for bicuspid. The facings in appearance should be selected in accordance with the rules given in "Selection of Porcelain Teeth," page 118. They should be of such a length that when ground in place, the base at the cervix will touch or rest on the gum, and the occlusal end on the antagonizing teeth, as shown in Fig. 524.

To determine the proper position of facings for producing the best appearance, they can be adjusted in the mouth supported on a narrow wax plate, with or without the gold crown or cap of the abutments.

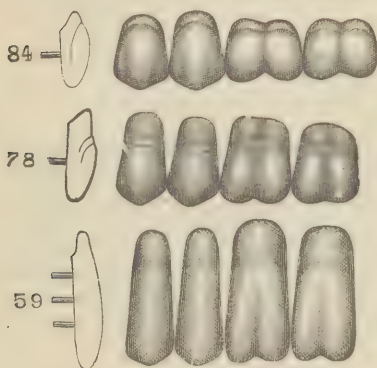


FIG. 523.

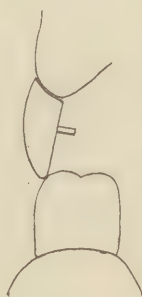


FIG. 524.

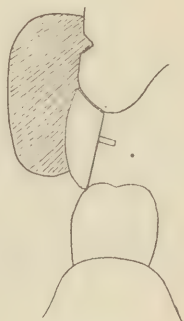


FIG. 525.

The facings having been ground and adjusted to correct position on the model, plaster is placed on the outside of the model, over the labial and buccal aspects of the facings, in sufficient quantity to hold them in position, thus forming a matrix, as seen in Fig. 525. The wax is then removed, exposing the lingual portion and permitting the forms and position of the teeth to be studied (Fig. 526). The base of the porcelain facings for the bicuspid pontics can be allowed to rest on the gum as ground, or they can be removed from their investment and the base of each uniformly ground from the lingual side beyond the pins (A, Fig. 527), straight to the labio-cervical edge (B), so that it only touches or leaves a slight space. This gives the form termed self-cleansing space. Forming the porcelain facing with the base resting on the gum, as indicated in Fig. 524, is in the opinion of the author preferable, as it excludes particles of food.

Another favorably considered method, as it eliminates the so-called self-cleansing space and offers a more agreeable surface to the tongue,

is to form the pontic with a base of slightly smaller circumference than the cervix of the natural tooth would be, as shown in Figs. 833, 834 and 835, and as used in removable bridge-work. The occlusal edge of the cuspid facing is shaped and protected with the backing, as explained in crown-work (Fig. 291). To make room for the gold occlusal cusp that

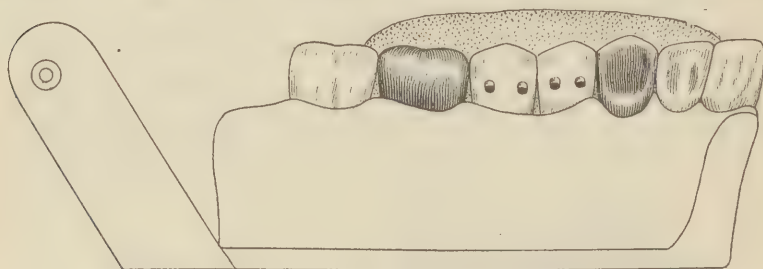


FIG. 526.

is to be added to the bicuspid facings, the porcelain is ground off at an angle of 45° to the line of the lingual side, as shown at A, Fig. 528, leaving a space at the extreme edge of about one-thirty-second of an inch, or, if protection of the porcelain is more to be considered than appearance, the entire end can be removed and restored with gold, as indicated in Fig. 529. To effect a uniform line of the gold and porcelain for ap-

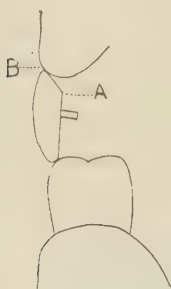


FIG. 527.

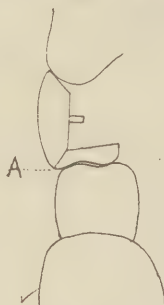


FIG. 528.



FIG. 529.

pearance, the angle for removal should be the same on all the facings and the line continuous, as shown in Figs. 530 and not as in Fig. 531.

Backings.—The bicuspid porcelain facings are next backed as in the case of a crown. (See page 182.) The backings, if preferred may be extended down on the curve of the self-cleansing spaces. A more desirable result is effected if the backing extends only to the edge of the self-cleansing space and the porcelain is polished, as its surface is superior in cleanliness to that of gold.

Occlusal Cusp-Caps.—Gold cusp-caps are made in accordance with the occlusion to form the occlusal portion as described and illustrated in the construction of gold crowns, either by swaging gold plate and filling in the cusps with hard solder or by casting (Fig. 532). (See Figs. 247 and 274.)

The plaster matrix is next removed from the surface of the model by prying it loose. The cuspid and molar crowns are warmed, removed



FIG. 530.



FIG. 531.



FIG. 532.

and boiled in water and soda to entirely remove the paraffin from inside the caps. The outside metallic surface of each crown adjacent to the pontics, is veneered with a film of hard wax, by heating the gold enough to melt the wax when touched to its surface, which causes the wax to adhere with great tenacity to the gold, and wax subsequently applied will then adhere to the wax veneer. (See page 15).

An ensemble is next made of the crowns, pontic bicuspid and occlusal cusp-caps with the matrix on the model. The different porcelains

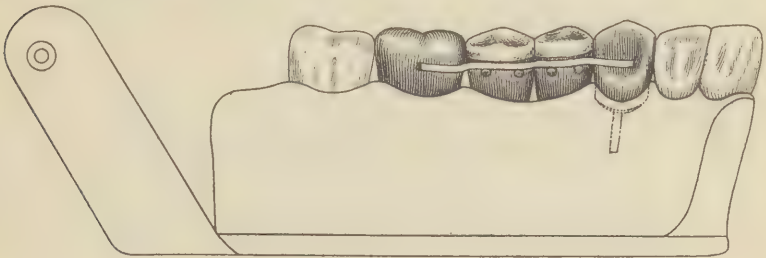


FIG. 533.

should appear to touch on the sides but should not actually do so—a slight space is necessary to allow for expansion and contraction of the porcelain without checking when heated in soldering. Should any touch, trim the side or sides with a revolving sandpaper disk. The pontic bicuspid and occlusal cusp-caps and crowns are first connected with a small amount of adhesive wax, and when correctly adjusted, reinforced with a large quantity of hard wax, and are then waxed to the abutment crowns. Wax should be placed in any seam or place where

it is desired to have the solder flow. A trifle of wax is applied in excess of the amount of solder required, so as to give a slight surplus of solder for finishing. A piece of iron wire about gage No. 12 to 15, bent on the ends, as shown in Fig. 533, may be heated and inserted in the wax as a brace. The wax is chilled, the matrix removed and then the bridge from the model, which is then invested, as seen in Fig. 534.

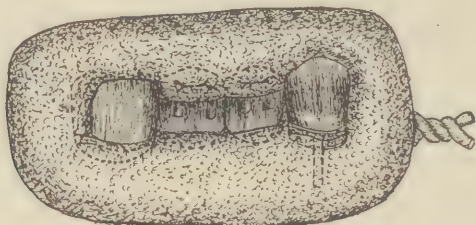


FIG. 534.

Investing the Bridge.—In investing a bridge, it is first dipped in water, the water shaken off, then a little investment material is placed in each cap or crown and in every crevice, with a small camel's-hair brush or a chip-blower, to insure it against air bubbles. A little more of the material than is sufficient to invest the bridge is next placed on a sheet of paper and the bridge is gently pressed into it, occlusal side up, and the material brought over in quantity a little more than enough to cover the incisal and occlusal surfaces, but the surface of the wax should be left exposed. (See page 33.)



FIG. 535.

To prevent fracture of the investment during the soldering process—which is liable to occur—and also to control its expansion and contraction and proportionately a displacement of the parts of the bridge, an iron wire about gage No. 15 with the ends twisted together, or a narrow strip of sheet iron or nickel with the ends joined, may be placed in the investment to encircle it, about one-eighth of an inch from the outer surface of the bridge, and low enough on the lingual side not to obstruct the exposure of the parts to be soldered (Fig. 534.)

When the investment is set, the wax is removed with boiling water and the investment trimmed. If any of the parts that are to be united in the soldering do not touch each other, the space between them should be packed with gold foil or Corona gold to act as a bridge for the solder. Pieces of gold wire may be used to aid in filling in the right-angle space between the occlusal cusp-caps and the backing of the pontics, as indicated in section in Fig. 535.

Soldering.—The case should be heated slowly. The soldering is best done on a concave soldering block or a piece of charcoal with a similar depression. (See "Soldering," page 34.)

Finishing.—After the soldering the bridge is removed from the investment and boiled in acid. The joints of the backings and crowns

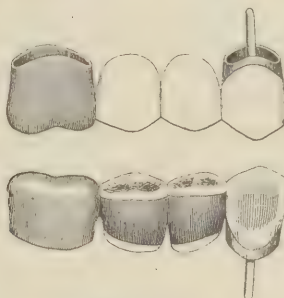


FIG. 536.

are trimmed and smoothed with carborundum wheels and points, finishing burs and leather points on the engine, also by a cord drawn between them (Fig. 62, Part I), and the entire bridge finely polished with whiting or rouge, carried by a brush wheel on a lathe. Any little pits that may exist can be shaped with a small bur and filled in with

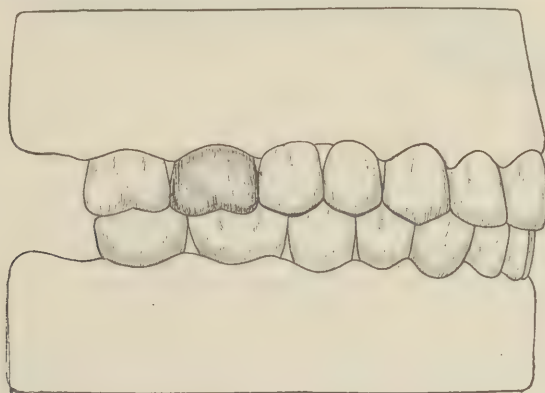


FIG. 537.

gold foil or Corona gold. (See Finishing and Polishing page 55.) The bridge is then ready for insertion (Fig. 536). If the construction details have been performed as described, a finished piece of bridge-work is the result.

Fig. 537 shows the finished bridge inserted in position.

Variation in Method of Construction

Construction in Sections.—To overcome warping and displacement of the abutment crown and pontic teeth from expansion and contraction of the investment material and gold solder, which occur especially when large bridges are soldered in one investment, the soldering is done in sections, to be connected in one or more soldering operations, as the case may suggest. For instance, in the finished typical case (Fig. 536) the bicuspid pontics could be removed in position, invested and soldered together, trimmed and replaced on the model, cemented with wax to the abutments, removed, invested and soldered to them.

Soldering on the Model.—Another method of constructing bridge-work is to form a model of the case of investing material and do the final soldering on the model. (See "Models," Part I, Chapter IV.)

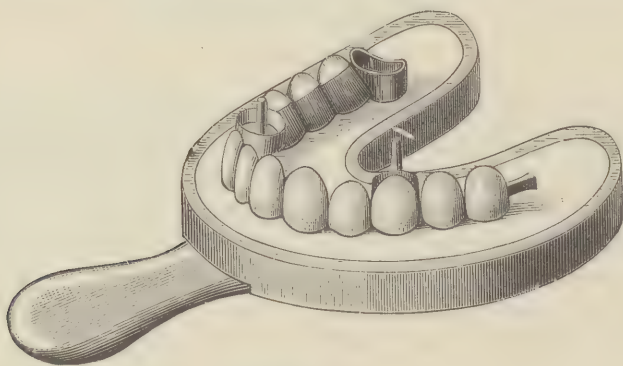


FIG. 538.

The abutment crowns are left in position on the model. The pontics are fitted between them and cemented with wax, the matrix removed, the model and bridge invested and soldered together.

Correction of Warping.—When warping occurs to such an extent as to interfere with proper adjustment, the bridge should be sawed apart where the displacement apparently has mostly occurred, in the manner least likely to affect its appearance. The parts are then cemented together with hard wax, adjusted in the mouth in correct position and an impression taken in an impression tray, using only sufficient investing material to cover the points of the teeth and crowns, as shown in the case of a larger bridge in Fig. 538. The bridge and the investing material are then removed from the impression tray and more investing material added to complete the investment. The sections of the bridge to be united are next exposed and soldered together. To permit the investing material to be easily removed from the impression tray,

it is well to melt a film of wax on its interior surface, then cool and serrate the surface of the wax. The plaster will adhere firmly to the wax but will loosen from the tray when the tray is heated.

Adjustment and Insertion.—The bridge when finished is adjusted in the mouth, every point carefully examined and any alterations required made. Should the edge of one or more of the abutment caps strike the edge of the occlusal surface of an abutment tooth or the end of a root, so as to interfere with the adjustment of the bridge, paint with a paste of rouge and oil with a small camels-hair brush the inside of that section of the cap, dry the surface of the crown or root and insert the bridge so that the rouge on the cap will mark the interfering part of the tooth or root. Grind off the marked interfering part, and repeat the process if necessary. Should the point of a post strike the dentin to one side of the orifice of a canal it is to enter, trim off the point of the post slightly on the interfering side and if necessary also the dentin at the edge of the orifice, sufficiently to permit the post to glide to position. Painting with rouge, either the post or abutment surface, as the case suggests, accurately defines the interfering point. If extensive warping has occurred in the soldering so as to prevent correct adjustment of the bridge, it must be remedied as described under head of "Correction of Warping."

Interfering points in the occlusion can be determined either by the use of marking paper, or by warming the surface of the gold, veneering it with wax and then occluding the teeth. By the latter method the interfering point or points are definitely marked in the wax.

When the adjustment of the bridge is accomplished, if desired, it may at first be temporarily inserted for a day or two, to permit it to settle into position and define any slight points in the occlusion that may require alteration. If the bridge is warmed and paraffin to which a little aristol has been added is placed in the caps before inserting, the secretions will be better excluded and a septic odor avoided. Burnishing the collars at the cervices will usually secure the bridge; if not, it can be cemented with a little gutta-percha placed in each cap instead of paraffin. Should there be evidence after temporary use of the need of changes, the removal of a little of the occluding surface of a crown or pontic at the required point, and of the antagonizing teeth, will generally be sufficient to correct it. For its permanent attachment the post of the cuspid crown may be slightly barbed and the cuspid and molar crown treated the same as for single crowns, and the bridge cemented on with either zinc oxyphosphate, silver chlorid antiseptic cement or gutta-percha, or a combination of both. (See "Cementation of Crown- and Bridge-work" page 256.)

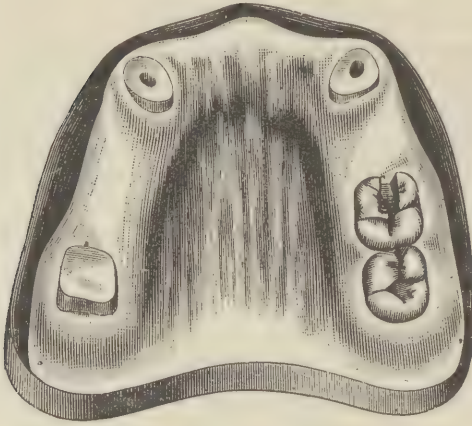


FIG. 539.

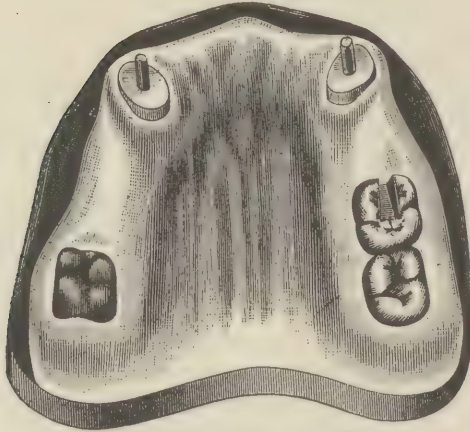


FIG. 540.

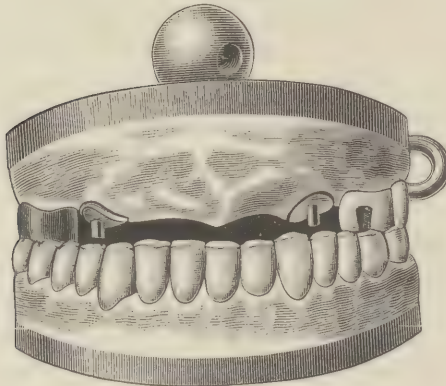


FIG. 541.

Construction of Bridge-Work Embracing Both Sides of the Mouth.

This is exemplified by the case illustrated in Fig. 539. Retaining abutment caps with posts are made for the two cuspid roots, a gold crown for the right second molar and a gold inlay for the left molar (Fig. 540). The walls of the inlay cavity should be inclined so as to permit insertion and removal of the inlay in an occlusal direction. A piece of iridio-platinum wire, gage No. 12 or heavier, should be inserted in the inlay wax, with its end protruding and cast in the inlay to afford easy and better attachment to the bridge. (See page 229.) An impression and bite are next taken. The inner or cavo and outer cervical surfaces of the caps, also the gold crown and the cavo-surface of the inlay are veneered with

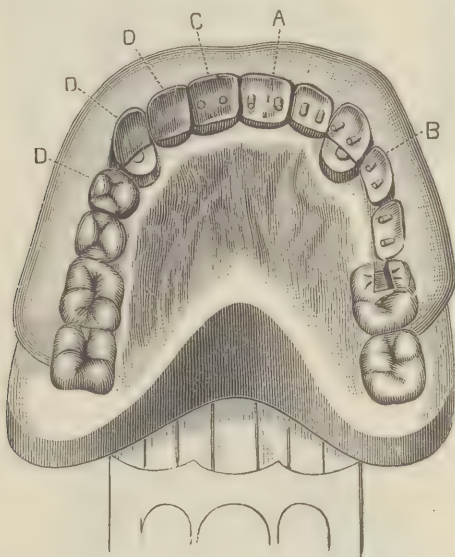


FIG. 542.—Shows pontics in various stages of construction. A, Central incisor, and B, bicuspid, ready for metallic backing. C is a central backed. D D D, porcelain fronts as they appear on insertion after the process of backing, capping, and soldering.

paraffin to later permit their removal, and models made, preferably of artificial stone, and mounted on an articulator with plaster, as shown in Fig. 541. (See page 24.)

Porcelain facings are selected and ground to position. The incisal edge of the cuspid crowns should be ground and shaped so that they can be protected with metal by extension of the backing, and the incisor, bicuspid and molar pontics treated in like manner. The model is then surrounded with a matrix and the facings backed and occlusal cusps made for the bicuspids and molars, as illustrated in Fig. 542.

The two cuspid crowns are removed from the model, invested, soldered and then readjusted on it. The right section of the bridge from the second molar to the cuspid, and the left from the inlay to the cuspid, are cemented together with wax, removed, invested and united with solder.

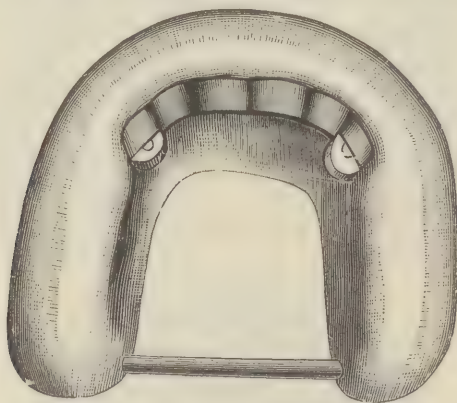


FIG. 543.

The incisors are next cemented together with wax, removed, invested, soldered and readjusted. The side bridges are then readjusted on the model, the four incisors cemented in position to the cuspids, with hard wax, and all removed together, invested (Fig. 543), and the three sec-



FIG. 544.

tions united with solder. Fig. 544 shows the finished bridge, and Fig. 545 the bridge in position. The inlay can be removed by means of the shank and strongly united to the bicuspid pontic. It is often necessary, to overcome contraction and secure a better relationship of the parts,¹

¹ In some cases, the best plan is to have the patient wear the bridge for a day before attaching the inlay, to allow the bridge to settle to position.

to solder together the entire bridge without the inlay and then adjust and unite the inlay to the bridge in a final soldering operation.

A variation in the inlay abutment in a case such as this is to use a supporting instead of a retaining abutment, as shown in Fig. 546, the

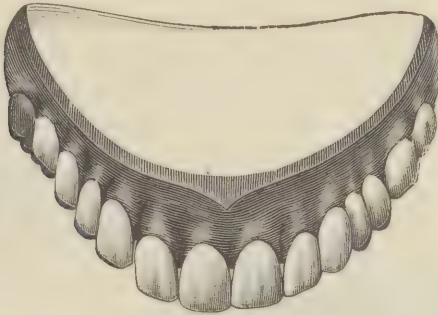


FIG. 545.



FIG. 546.

construction of which is described on pages 329 and 330, and in Removable Bridge-Work (page 398.)

Construction of Small Pieces of Bridge-work

This is much simplified by the following methods: Crowns are first made for the teeth or roots that form the abutments and temporarily

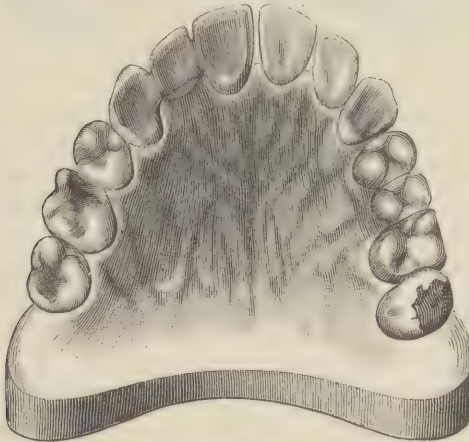


FIG. 547.

placed in position. The teeth—pontics—which form the span, having been ground and backed, preferably with the aid of a model, are adjusted and attached with wax cement in proper position between the

crowns. The crowns and pontics are then removed together in an impression tray filled with investing material, the inside surface of which has been veneered with wax and the surface serrated. The impression tray is then heated and the investment with the crowns and pontics removed. More investing material is mixed and the exposed parts of the crowns and teeth covered. The investment when set is cut away sufficiently to expose the parts that are to be filled in and united together in the soldering process. Figs. 547 and 548 represent

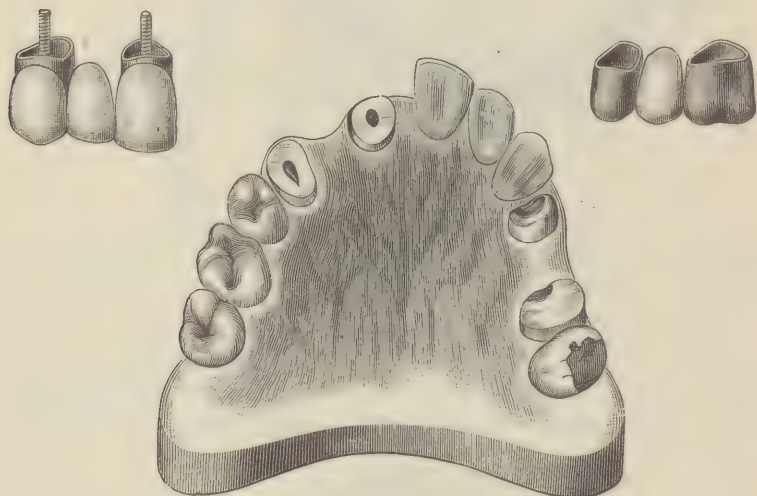


FIG. 548.

cases of bridge-work constructed in this manner. Parts of a larger bridge constructed in sections may be similarly formed and then united.

In an extension bridge of one tooth with the addition of a supporting abutment, a method that can often be practiced is; to properly adjust crown and pontic tooth or teeth cemented together with wax in the mouth, carefully remove them in position, invest and unite with solder. The supporting lug can then be added to the pontic, to rest on or in the intended tooth and form the supporting abutment.

CHAPTER II

REPLACEABLE PORCELAIN FACINGS AND TEETH

The replacement of a fractured porcelain facing that has been attached by soldering to a bridge permanently cemented with oxyphosphate is frequently attended with great difficulty, and the result is often unsatisfactory and doubtful regarding permanency.

Change of shade of the porcelain facing or tooth is liable to occur, especially when subjected to more than one soldering operation, when accuracy in shade is a positive requirement.

Fracture of porcelain in soldering retards the construction of the work and involves the labor of its replacement.

The desire to obviate such difficulties has caused the introduction of various methods of construction, in which the porcelain facings are removed from their position previous to the soldering process and afterwards readjusted and cemented so as to be easily replaceable by duplicates in case of fracture when the work is being worn in the mouth.

To simplify the application and increase the use of replaceable porcelain facings, special forms are now manufactured and sold.

Replaceable Ordinary Porcelain Facings with Cast Box Backing.

In making a cap for a crown to receive a facing sweat the collar to the floor or solder it with the least possible quantity of hard solder; also use very little solder to connect the post. Select a porcelain facing with long pins and register the number of mold and shade. This should always be done in all styles of replaceable porcelain facing work.¹

Grind, fit and bevel off the incisal edge of the facing in the usual manner for a crown or pontic. Point the pins in a cervical direction with a slight curve, as shown at B, Fig. 549.²

When the facing is ground and fitted, remove, cleanse in boiling water, dry, oil the surface and wipe off surplus. If *it is the case of a crown*, remove all the wax on the cap. Remount the facing on the cap and shape up the lingual side with inlay or hard pink base-plate wax (A, Fig. 549). Chill wax and remove the porcelain facing, leaving the wax on cap (B). Insert graphite points in pin holes in wax (C), insert sprue wire, invest in casting flask and cast in 22-carat gold.

¹ To have on hand a duplicate set ground and ready to replace the worn one is a good plan.

² The description given is for platinum pin facings. Most of the alloy pins now in use will not well permit bending.

When cast, adjust porcelain facing to backing. Ream out with a small bur any obstructions that it may offer to the proper insertion of the pins and enough to provide space for their bent form (B). Cement facing to position and retain under pressure for a few minutes (D). If possible, avoid insertion in the mouth until the next day. The same

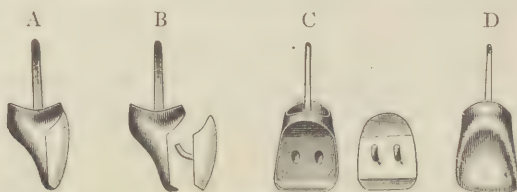


FIG. 549.

method of construction is applied to pontics. The backings can be cast together or separately, then joined with solder and united to the abutments in the usual manner. It is not advisable to cast backings of abutment crowns and pontics in one piece.

Manufactured Replaceable Facings and Teeth

The S. S. White Interchangeable Facing.—This form of interchangeable facing possesses advantages in strength and ease of manipulation.

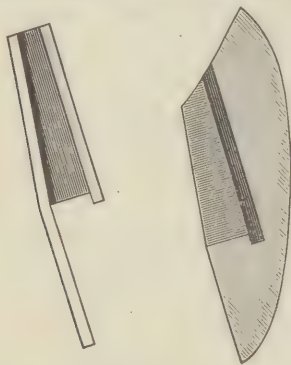


FIG. 550.

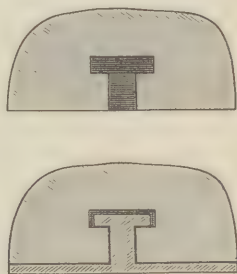


FIG. 551.

Fig. 550 shows in vertical section the formation of the facing and backing and Fig. 551 in cross-section the facing without and with the backing.

The facing is beveled on the lingual surface at a very slight angle (6°) from about what would be the position of the pins in a pin facing to the incisal edge. A flat rectangular recess or key-way, paralleling the line of the bevel, extends from the ridge-lap to *just beyond* the beginning of the bevel. A slot connects the key-way with the lingual surface, ending *at* the bevel.

The backing-plate is angled to fit the lingual surface of the facing and carries a key that fits the key-way snugly; but not so tightly as to

prevent easy manipulation. The key, which is set at the same angle as the incisal bevel of the facing, is connected to the backing-plate by a web that fits the slot just as the key fits the key-way. Backing-plate, key and web are made in one piece, without soldering, the head of the key



FIG. 552.



FIG. 553.

FIG. 554.

projecting slightly beyond the web. Through this construction the key and backing begin to engage with the facing when the key enters the key-way, and facing, key and backing-plate are locked together by a wedging action when the key finds its seat. The inclined key-way tends to obviate any line of breakage possible with a key-way parallel with the surface, and by the locking action which it facilitates distributes the stress. The backing plates are made in several sizes to suit any size of facing and allow for trimming.

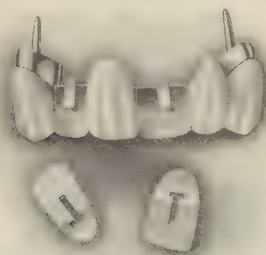


FIG. 555.



FIG. 556.

Figs. 552 and 553 show facings and backings untrimmed, the former for the smaller teeth, the latter for the larger sizes. In crown- and bridge-work after the proper alignment is secured, the backing-plate is trimmed and the backing completed by the usual methods.

Fig. 554 shows the S. S. White Interchangeable Facing with coping and post and its application in section to an incisor or cuspid collar crown (Richmond). Figs. 555 and 556 show the application to bridge-work for abutments and pontics.

The Steele.—This form has a round slot in the center of the porcelain facing into which is closely fitted and glides a metal flange, which is united to the backing, as shown in Fig. 557.

Figs. 558 and 559 show a finished pontic and crown with Steele facings.

The backings of Steele facings are extended slightly to protect respectively the incisal and occlusal edges of the porcelain. Fig. 560

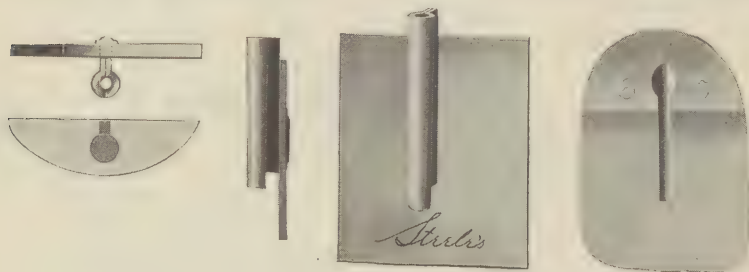


FIG. 557.



FIG. 558.



FIG. 559.

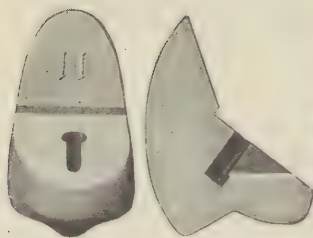


FIG. 560.

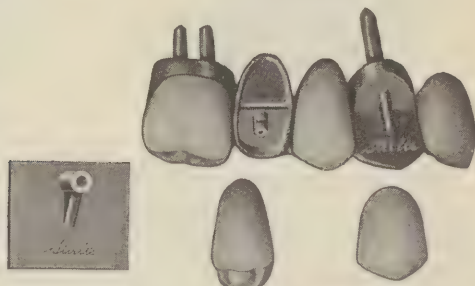


FIG. 561.

shows a Steele bicuspid porcelain tooth with a porcelain occlusal section with another form of backing. Fig. 561 shows the facings and tooth applied to a bridge.

The Ideal.—In this style the porcelain facing is attached by a rounded flange on a manufactured backing with a pin on the point of the flange that enters the facing. The flange fits into a round slot with an extension for the pin, as shown in Fig. 562. The end of the slot forms a shoulder to the hole for the pin. The pin additionally secures the flange. The position of the pin in the porcelain is such as to

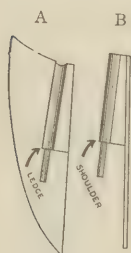


FIG. 562.



IDEAL BRIDGE WITH CUSPID REMOVED

FIG. 563.



FIG. 564.

leave the incisal edge of the facing intact. Fig. 563 shows a bridge with Ideal facings, the left cuspid removed. Fig. 564 illustrates a posterior Ideal backing and tooth.

The Evslin.—In this form the porcelain facing is made with a dove-tail socket to receive a lug extending from the backing. Fig. 565 shows an anterior facing and flange, and Fig. 566 a posterior tooth with a porcelain occlusal section.

After the porcelain facing has been fitted, the gold or platinum backing is swaged to the porcelain. The end of the flange that fits into the



FIGURE 1



FIGURE 2



FIGURE 3

FIG. 565.



FIG. 566.



FIG. 567.

socket of the facing is protruded through a perforation in the backing and cemented with wax (Fig. 567). It is then removed, invested and soldered to the backing.

As the porcelain is tipped at an angle as it is adjusted to the backing, it admits of the incisal edge of anterior teeth being protected, as shown in Fig. 568.

The Dimelow.—The principle in the construction of this facing is to secure mechanical anchorage by having the pins, which are fastened

in the backing, slant in the porcelain from lingual to labial, incisally. The facing has two holes placed in the location to be occupied by the pins, as shown in section Fig. 569, the backing in Fig. 570, and the facing backed in Fig. 571. In the construction, the backing is swaged to the facing. Holes are made for the pins, which are then adjusted in the porcelain through the backing, cemented with wax, backing and pins removed, invested and united with hard solder. The angle at which the facing is cemented to the backing permits protection of the incisal edge, as is indicated in Fig. 571.



FIG. 568.



FIG. 569.



FIG. 570.



FIG. 571.

The methods and forms of replaceable porcelain facings presented are the representative ones mostly now in use.

Impartially Considered.—Fracture of porcelain facings is not to be seriously considered, except in unfavorable occlusions. In the construction of the work the percentage of such accidents is small, and usually attributable to carelessness in soldering or lack of skill. Change of shade in porcelain will occur, when heated several times, but generally it is only slightly apparent.

In respect to strength and liability to fracture in use, a properly applied and constructed soldered porcelain facing is stronger than a replaceable one. If fracture of a soldered facing should occur, its replacement on a cemented bridge is difficult and uncertain in result. Therefore in cemented bridge-work where removal would involve partial or entire destruction, unless conditions of the case permit of proper and most reliable protection for the porcelain, the use of replaceable porcelain facings is advisable.

The cementation of facings to backings and caps provides continuity of structure for the parts under and around the porcelain. This is not entirely secured in soldered facings, no matter how carefully constructed.

CHAPTER III

SPECIAL PROCESSES AND APPLIANCES IN BRIDGE-WORK

Shoulders on Superior Incisor and Cuspid Crowns or Artificial Teeth.—Shoulders on these teeth at the point of occlusion with the inferior are sometimes desirable, especially when it is necessary to open the "bite." To so construct, bevel the lingual side of the incisal edge of the porcelain facing and back with platinum, gage Nos. 38 to 40, or pure or platinized gold plate, gage Nos. 31 to 32, allowing it to extend over the incisal edge one-thirty-second inch, as shown at A, Fig. 572. To form the shoulder, cut a piece of gold plate, bend and adjust it to the incisal section in accordance with the occlusion,

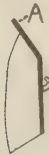


FIG. 572.



FIG. 573.

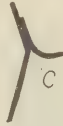


FIG. 574.



FIG. 575.

as shown at B, Fig. 573, and cement it with wax to the backing, remove backing, invest and unite plate to backing with a small quantity of solder, as indicated at the point C, Fig. 574. Replace backing on porcelain facing, bend the pins, if made of platinum, and fill in the space to the dotted line D, Fig. 573, in the soldering of the bridge. A shoulder also can be added by making a wax model of the portion to form the shoulder, casting it in 22-carat gold and then soldering the casting in position on the backing.

A cuspid crown may be advantageously used at times to open the "bite" to assist in supporting the force of occlusion by giving it the form of a bicuspid. The following is descriptive. Make cuspid crown for root with beveled and protected incisive edge, using enough hard solder to connect backing to cap. Shape up the lingual side with inlay wax to a form approaching that of a bicuspid, remove the wax model and cast with pure gold (Fig. 575). When cast, wax to backing and invest. Heat casting with pointed flame sufficient to melt the solder already on

the backing and attach the casting, then flow 18- to 20-carat solder over the seam to entirely fill it and insure a slight surplus for finishing.

Solid Gold Pontics

In a close occlusion, when the patient prefers strength to appearance, the bicuspid and molar pontics may be made of solid gold.

Casting Method.—For one or more pontics, moisten or slightly vaselin the surface of the model and press inlay wax between the abutments, tightly occlude the articulating model, and get an imprint of the antagonizing teeth. Chill the wax, trim and carve it to the desired form, removing and placing it on the model during the operation. Insert a sprue wire, as shown in Fig. 576, which illustrates a single pontic ready to be invested and cast.

Sectional Method.—Stamp a piece of pure gold plate, gage No. 31, to represent the occlusal surface (A, Fig. 577). Shape up the form of the remainder of the pontic in wax, and over the wax adapt an annealed piece of pure gold (B), gage No. 32, to the buccal, mesial and distal sides, leaving the lingual open. Invest buccal side down and fill from the lingual side with scraps of 20-carat plate or coin gold.

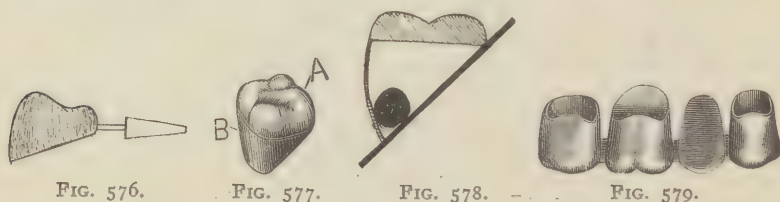


FIG. 576.

FIG. 577.

FIG. 578.

FIG. 579.

Seamless Cap Method.—Stamp and fit a seamless crown to the space. Slit and lap the sides, if necessary to bring them into form, and then partly or entirely remove the lingual side. Fill the inside with wax, invest and melt-in a lower-fusing gold than the cap.

All-Gold Hollow Pontics.—All-gold hollow pontics are recommended in a large proportion of cases in preference to solid ones, especially for lightness. They are formed as follows: Take a seamless gold contour crown of suitable size, articulate it to the antagonizing teeth and reinforce the interior of the occlusal surface with a slightly lower-fusing gold plate. Cut away the gold of the lingual section of the collar to the form termed self-cleansing and shape the neck of the crown. Melt a small quantity of hard solder with flux into the form of a globule; fit a piece of gold or platinum plate, about gage No. 32, over the open side, flux the edge of the gold crown and place the ball of solder on the gold or platinum, within the gold cap (Fig. 578). Hold

the cap in a Bunsen flame and heat slowly until the solder melts and appears around the edge of the cap, then instantly remove from the flame, trim the gold or platinum and stone the edges. This gives a hermetically enclosed pontic of gold, from the interior of which the air has been practically exhausted by the heat. The pontic can then be placed in its position on the bridge and soldered in the usual manner. Fig. 579 gives the lingual aspect of a bridge, the pontics of which were constructed in the manner described. The bicuspid pontic is given a self-cleansing form and the molar is shaped to rest on the membrane.

Anchorage Cavity in a Solid Gold Crown.—An anchorage cavity in a solid gold crown, to support the end of a bridge with an inlay or bar (Fig. 580), is constructed as follows: The natural crown is ground down and the cervix shaped, banded, capped and pivoted, as shown in Fig. 581. The gold or platinum forming the floor of the cap on the root is made flat and left projecting a little at the sides.

The form of the remainder of the crown is shaped in wax on the root-cap and chilled. A cavity is then made in the wax of the form required for the slot or cavity to receive the inlay or bar. This is best done with a fast revolving fissure bur in the engine. Remove the wax model from

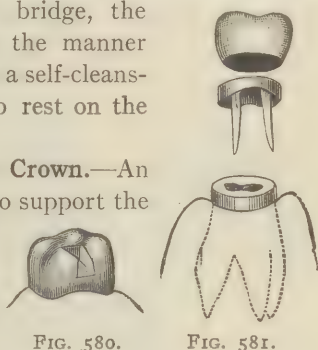


FIG. 580.

FIG. 581.

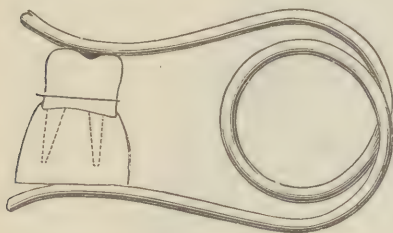


FIG. 582.

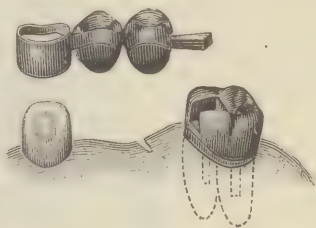


FIG. 583.

the root-cap, invest and cast. The cast crown is then adjusted in proper position on the cap. The cap is filled with investing material and the gold crown wired or clamped to it, as shown in Fig. 582, and united with solder to the cap, making a perfect joint. This method is usually only applied when a *short crown is required*.

Fig. 583 illustrates from the palatal side a bridge of two solid gold bicuspid pontics supported by a bar anchorage in a solid gold crown on the roots of a molar, and an open-face crown on a cuspid.

Anchorage Cavity in a Gold Cap-Crown.—A heavy seamless crown is a very suitable form for insertion of a socket. If a crown made in sections is used, the cusps should not be reinforced until after the socket has been attached. Cut out of the side and occlusal surface of the crown the required space for the socket, as shown at A, Fig. 584. Fit a box formed of two L-shaped pieces of gold or platinum plate in the space, as seen at A and B, Fig. 585, cement with wax, invest,

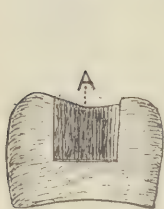


FIG. 584.

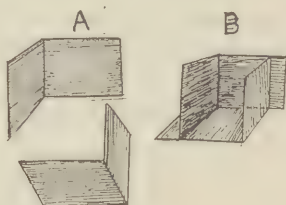


FIG. 585.

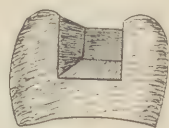


FIG. 586.

and solder from the inside, also reinforcing the cusps. Fig. 586 shows the finished socket.

A preferable method is to make the crown in sections with a cast cusp-cap in which the anchorage cavity has been formed.

Connecting Bars for Bridges.—To connect sections of bridge-work between which natural teeth intervene, bars are used. The bars are made of round or oval-shaped clasp gold or iridio-platinum wire, about gage No. 14. The wire is carried around back of the intervening teeth,

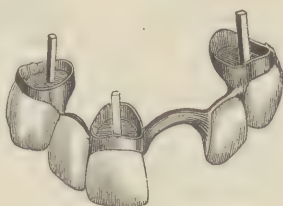


FIG. 587.

close to but not touching them, and resting lightly against the gum, so as not to cause too pronounced interference with the tongue. This is accomplished by very slightly indenting the bar in the surface of the model before soldering (Fig. 587). Waxed floss-silk should be daily drawn under such a bar.

Intervening Roots.—An intervening root in a hygienic condition not suitable for crowning, between the abutments of a projected bridge, when practicable may be allowed to remain. The root is to be given

preparatory treatment and a porcelain or gold inlay inserted that will cover the end of the root and be even with or a little above the surface of the gingiva on the lingual side. A root so treated can be utilized to

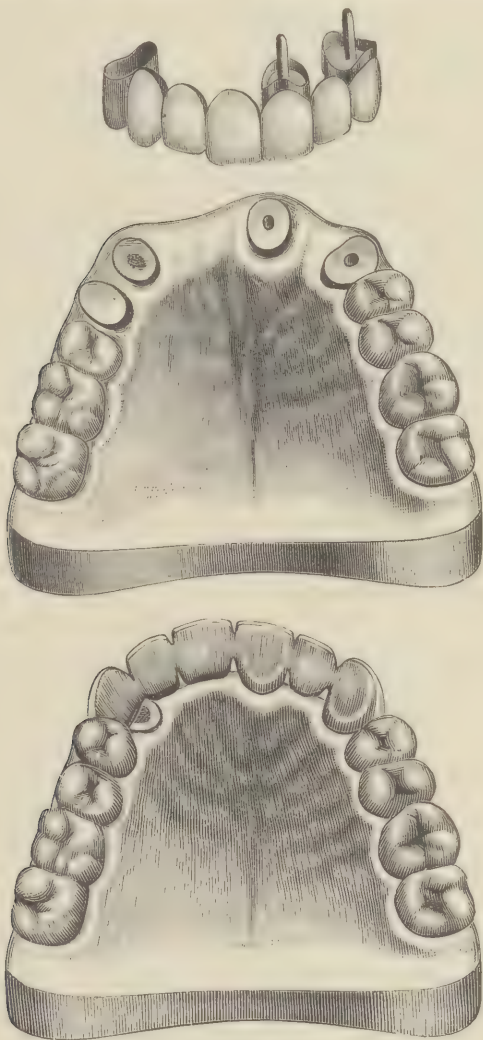


FIG. 588.

afford some support by resting the bridge upon it. Fig. 588 represents a case in which the root of the cuspid on the right side has been so treated and utilized.

CHAPTER IV

ATTACHMENTS FOR FIXED BRIDGE-WORK

Open-face Crown Attachments

The use of the open-face crown as a bridge abutment is often advantageous and serviceable, when properly constructed and applied in suitable cases. Its use is mostly confined to superior cuspids and bicusps and inferior incisors and cuspids. It does not require removal of the pulp.

Preparation of the Tooth.—Parallel the sides and remove enough of the contour on the cervico-lingual section to permit the gold to fit at the neck. Grind off enough of the lingual or occlusal surface of a superior tooth, to allow a space at least equal to gage No. 23 between it and the antagonizing teeth. Slightly bevel the lingual side of the incisal edge of the inferior teeth, to avoid showing gold. If possible, avoid removal of any of the labial surface.

To Form a Die.—Take an impression in a tube (A, Fig. 589) with plaster, and make a fusible metal die (See pages 28 and 29) or take the impression with compound in a tube and make an amalgam die (B). If an amalgam die is formed, it is advisable to first take a moldine impression of the die in a tube and run a fusible metal die for the preliminary shaping of the gold cap, reserving the amalgam die for the final details.

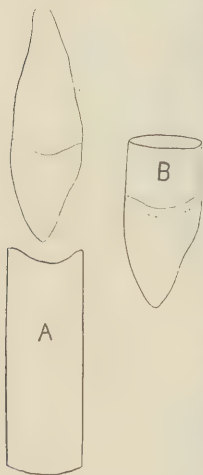


FIG. 589.



FIG. 590.

Seamless Open-face Crown.—Select a gold cap that fits the neck of the die closely. Tap and shape the cap to the form of the die. Remove the gold cap and anneal it. Replace on die and swage in a counter-die. A swager can be used as a counter-die. (See Fig. 25.) Fit the crown on the tooth and mark on the gold the portion necessary to remove to expose the labial surface. Make a hole with a bur through the gold, and with a fine fissure bur cut out the marked portion and finish with carborundum points. Reburnish the crown on both die and tooth. To better resist the strain of the bridge at the cervico-labial part, especially when the strip is cut narrow, reinforce it with an additional slightly

narrower strip of the same gold as the crown, soldered across the surface and extended around on the sides, as shown in Fig. 590. The strip should be beveled off evenly to the surface of the remainder of the gold.

Open-face Crown, Sectional Construction.—Fit a gold collar around the tooth long enough to extend considerably beyond the incisal edge and remove the gold at the labial aspect, as shown at A, Fig. 591. Partly remove the gold on the lingual side and adapt the collar to the sides of the tooth, as seen at B. In the vacancy between the collar and tooth at the lingual side, fit and burnish a piece of pure gold 30 gage or, in the case of a very close "bite," thin platinum plate about 38 to 40 gage, which will cover the exposed surface at that part and fit in under the edge of the collar. C shows the usual form of the piece of plate before it is fitted to the collar. Fill in the space between the collar and piece of plate with adhesive wax; remove the collar, invest and flow hard solder into the space between the piece of plate and the collar, also a film over the plate, remove the surplus gold and trim level. D and E show a finished open-face crown with an incisal edge covered and exposed.



FIG. 591.

Another method for the construction of an open-face crown preferably practiced by some is; form a gold collar wide enough to extend well beyond the incisal edge, remove the portion of the gold from the center of the incisal section, and slit the palatal surface on both sides of its center, as represented in Figs. 592 and 593. The part at A is bent back, the edges of

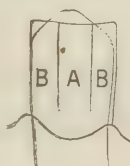


FIG. 592.

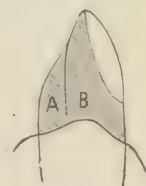


FIG. 593.

the parts at B, B are beveled and bent down on the tooth and burnished close to its surface. The piece A is next brought down in position over the parts B, B, and adapted to the crown.

The collar has now assumed the shape of a gold crown with an open face and seams (Fig. 593). The seams are next united by flowing solder into each of them—a little at a time—by holding the crown with tweezers in a Bunsen flame. The seams will hold and retain solder sufficient to join and fill them without the solder flowing over the adjacent parts, unless an excess of heat or solder is applied. When the

soldering is completed, the crown is adjusted, a line showing the exact portion of the labial aspect to be exposed marked on the gold, the crown removed, its edges trimmed to the mark and the soldered parts trimmed level.

Fig. 594 illustrates a bridge in which the inferior incisors are supported by open-face crowns on the cuspids. Fig. 595 represents the replacement of the inferior bicuspid and a molar on the right side by a

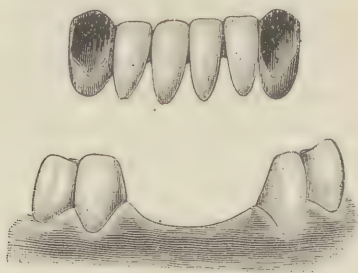


FIG. 594.

bridge with an open-face crown on the cuspid and an all-gold crown on the molar.

The Cementation of Open-Face Crown Attachments.—To secure a better adhesion of the cement in the cementation of such crowns, the surface of the enamel should be cleaned with pulverized pumice, wet with aromatic sulfuric acid. The tooth is washed and dried perfectly. The cement should be thoroughly mixed to the consistence of a thick cream, the inside of the crown and band covered with it, then the surface



FIG. 595.

of the tooth—especially the cervico-labial section—and the bridge brought to position.

When the strip of gold which traverses the cervico-labial section is made narrow, the liability of the cement to wash out at that part in time is one of the difficulties connected with the use of this form of cap attachment. On the inferior teeth this band of gold not being so liable to exposure can be allowed to remain wider.

Fig. 596 shows forms of partial cap attachments for bicuspid that require the least possible removal of tooth structure. They can be stamped seamless then externally reinforced. When the gold

is removed at the cervico-buccal part, the crown can be additionally secured by a pin introduced and soldered, as shown at A, also in Fig. 597, supporting a pontic. A more secure form is to cut two grooves, as shown in Fig. 598, on the mesial and distal sides of the natural tooth, for the reception of two small iridio-platinum pins 21 gage, passed through and soldered to the occlusal surface. If a line of wax is placed between the pins and the cap on the cavo-surface before investing, the solder may be partly drawn in between each pin and the gold of the cap, to better secure the pins, by directing a large flame under the investment.

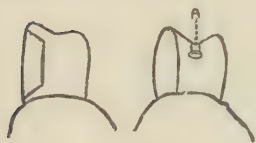


FIG. 596.



FIG. 597.

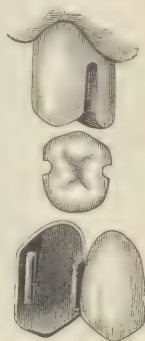


FIG. 598.

In most cases where open-face crowns are used on the upper teeth the gold forming the distal side of the cap can be brought around slightly on the labial surface of the tooth, without being observable when viewed from the front; but it must be cut short at the mesial side, and not allowed to extend beyond the line of the porcelain facing when placed beside it, as seen in Fig. 597 and 598. On the inferior teeth the band of gold which extends across the cervico-labial aspect needs to be removed only enough to avoid exposure in speaking. Consequently much more gold may be left at that section on inferior than on superior teeth.

The Carmichael Attachment.¹—This attachment is for use on teeth with vital pulps. It consists of a partial cap that covers the prepared natural crown on the lingual, approximal and incisal or occlusal surfaces. It is retained by a groove that runs across the incisal or occlusal

¹*Partial Cap, Inlay and Plate Attachments.*—As a bridge abutment a small plate adjusted to the lingual surface of a central or cuspid secured by one pin in the center of the lingual surface was introduced by Dr. W. F. Litch in 1886 and plate and inlay attachments secured by two or more pins by Dr. C. L. Alexander in 1896. The use of a partial cap attachment retained by diverging retaining grooves which did not require pulp extirpation was described by Dr. F. L. Marshall and Dr. J. P. Carmichael about 1900. Dr. Marshall's attachment was retained by a staple fitted in a groove under the cap and Dr. Carmichael's by indenting the plate of the cap into the groove by swedging. The Carmichael is the form now generally used.

surface horizontally and at a right angle thereto on the approximal sides towards the cervix.

The use of this form of attachment is mostly confined to cuspids, bicuspid and molars but it is occasionally applied to superior centrals.

Preparation.—For cuspids first remove with stones and disks the enamel from the lingual side to about one-sixth of an inch from the gingival border. Next trim the approximal sides and bevel the incisal edge in a lingual direction. At the cervical section form a small shoulder along the line of the gingival border as shown in Fig. 599 with small square-end carborundum stones and burs. Cut mesio-distally a shallow longitudinal groove across the incisal section with a small disk, and enlarge it with a round bur (18 gage). Next with cross-cut taper shape fissure-burs extend the groove down the approximal sides to the

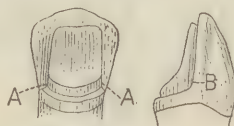


FIG. 599.

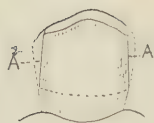


FIG. 600.

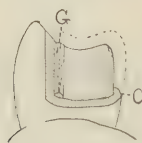
FIG. 601.
C. Cervical ledge.
G. Groove.

FIG. 602.



line of the shoulder formed at the cervical section, as indicated at AA, and B. The grooves on the approximal sides should taper slightly and be parallel with the line of any other attachments present to allow insertion and removal in an occlusal direction. In a case where there is no objection to a display of gold, the bulge of contour can be removed on the approximal sides.

In preparation of bicuspid and molars trim the approximal sides (AA, Fig. 600). The occlusal surface should be removed to leave a space of about 26 gage (Fig. 601). This can be assisted in many cases by the removal of a point of an antagonizing tooth. In incisors and cuspids care should be taken not to weaken the incisal edge by the formation of a large deep groove which is not necessary for retention. In bicuspid and molars the same preventive measure should be taken and as a precaution the cusps can be reduced and the entire occlusal section covered with the gold.

The use of preparatory plaster or artificial stone models is of great assistance as affording a guide in shaping the teeth and forming the grooves parallel, so they will have a corresponding relative direction with other attachments. To test and insure this when the attachments are made, solder a No. 12-gage bar to the attachments and apply them to the teeth in the mouth. The pontics can be fitted to position and soldered to the abutments without interference from the bar if it is soldered to the lingual side of the attachments, after which the bar can be removed.

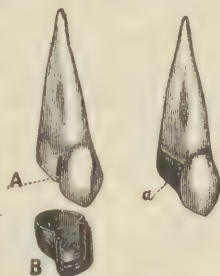
Construction.—The wax model is made by forming a wax cap over and around the tooth the shape of the required crown by either the direct or indirect method, or preferably the combined use of both. The form of the occlusal surface is defined by occluding the teeth.



FIG. 603.

The sides of the wax cap are

trimmed and shaped to make a flush joint with the cervical ledge (A; Fig. 599 and C, Fig. 601), and the wax on the labial or buccal surface entirely removed. The sprue wire is inserted as shown in Fig. 602 and 603. The wax cap is then removed, invested and cast. An alloy formed of two parts 22-carat gold plate and one part clasp gold is recommended for these caps.¹ It contains about four per cent. platinum.



A, Groove in tooth
B, Cap.
a, Cap in position.

FIG. 604.

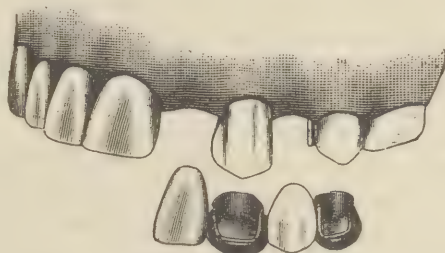


FIG. 605.

Another method¹ is to first shape over the amalgam die of the tooth a shell of No. 30 gold foil, then place and shape the wax model over the foil, remove and cast.

Fig. 604 shows a Carmichael attachment off and on a bicuspid. Fig. 605 shows a bridge with Carmichael attachments.

¹ A Carmichael Method.

Fig. 606 shows a Carmichael attachment utilized to support a first bicuspid pontic with a lug to rest on the cuspid.

Three-pin Inlay Attachment.—This form of attachment when applied to a tooth with a vital pulp is mostly used to support a lost adjoining tooth, or to assist in supporting the end of a bridge in connection with other abutments.

Fig. 607 will be used as a typical case to explain the method. Remove enough of the lingual side of the cuspid to form a depression or shallow cavity and, if necessary, the incisal edge of the lower tooth, to leave a space equal at least to gage No. 22. The trimming is best done with small wheels or points, so that the part assumes the shape of

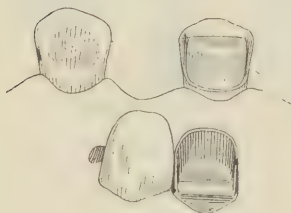


FIG. 606.



FIG. 607.

a depression with a defined ledge forming the margin, as shown at L, Figs. 607 and 608. Three holes, size of gage No. 20, are next drilled on the palatal side, one each being placed at the approximal sides and towards the cervico-lingual section. These holes are drilled parallel with the axis of the tooth, as indicated in Fig. 608. The holes at the approximal sides are to occupy that portion of the tooth structure which is generally included in approximal decay that does not expose the pulp. If a gold filling or inlay occupies that portion, it should be drilled into the same as though it were the tooth. If the filling or inlay is a substantial one, it will not be disturbed.

Construction.—Take an impression in compound of the lingual side of the tooth, make an amalgam die and mount in a swager. Swage and adapt to the lingual surface, extending onto the approximal side where the artificial tooth is to be adjusted, a piece of platinum plate about gage No. 38. This little plate of metal is fitted to the surface of the tooth and perforated over the holes. Three iridio-platinum pins, gage No. 20, which have been roughened by rolling under a file, are next inserted in the holes, attached to the plate with wax, the whole removed, invested and soldered with pure gold. Only one pin may first be inserted and soldered and then the others added. Fig. 609 shows the cavo-surface side of the plate. The plate is next refitted, edges trimmed,

removed, invested and reinforced with a veneer of pure gold. It is then fitted, invested and reinforced with coin gold. The artificial tooth is attached to the plate and a lug added, resting on the central incisor, as shown in Fig. 610.

A three-pin inlay attachment can also be made by the casting method. When so formed the wax model is best made by the direct method. Place the pins in the holes in the tooth and press the wax to position over them, trim wax, remove and readjust until the model is correct in form with pins in position.

The line of the pins in the tooth structure being close to that of the line of force exerted in mastication prevents displacement and better permits insertion and removal of the attachment during the construction.

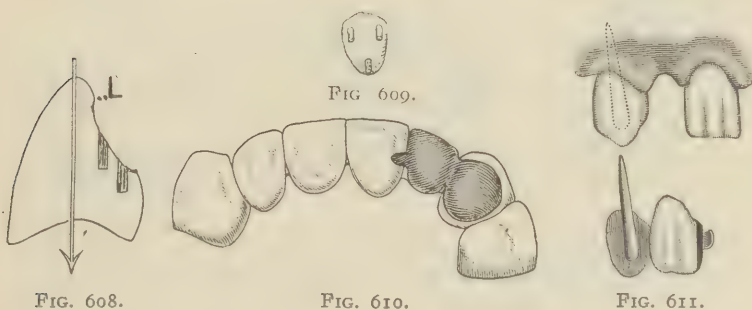


FIG. 608.

FIG. 609.

FIG. 610.

FIG. 611.

As a support for teeth loosened by pyorrhea, this pin cap attachment, in some cases, may be used without removal of the pulp. On account of the narrowness of the lower incisors, its application is usually confined to the cuspids.

Use with Pulpless Teeth.—In pulpless teeth only one pin extended into the pulp-canal is necessary, as illustrated in Fig. 611. Small or narrow teeth require the removal of the pulp and the use of a single pin.

Inlay and Bar-Bridge Attachments

Attachments of this style are employed to anchor the ends of a bridge in the coronal section of natural teeth used as abutments. Failure to appreciate the limitations of this device and faulty construction are responsible for disappointments in its use. Its employment should be confined to pulpless teeth, or to teeth whose form permits, or in which calcification of the pulp allows a deep and secure anchorage of the inlay or bar. When one end of the bridge is retained by a crown, the other end may be retained by an inlay or bar. In the case of pulpless

teeth, an inlay or bar in certain cases may be used on each end of a bridge of one or two teeth, and occasionally three teeth, but not reliably on more.

Inlay Attachments

Incisors and Cuspids.—This form of attachment is seldom used except in pulpless incisors, or where extensive calcification is present, owing to the difficulty of obtaining sufficient depth for an anchorage inlay when the pulp is present. The three-pin inlay,



FIG. 612.

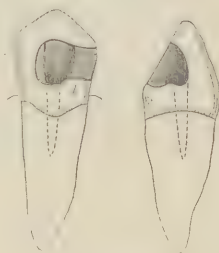


FIG. 613.

and Carmichael attachments offer preferable forms of support. In the case of cuspids, the use of an inlay is more frequent, as their form is more favorable.

Cavity Formation.—In an incisor or cuspid with a vital pulp the anchorage cavity is formed in the lingual portion of the tooth, extending from the approximal surface next to the space to be bridged, two-thirds to three-fourths or entirely across to the other approximal side.

The cavity should be given a retentive form with a flat base and with sides cut straight or diverging only very slightly from a right angle to the orifice, as shown in Fig. 612. One or two pins may also be inserted. When the cavity is to constitute one of the supports of a bridge with a crown that can only be adjusted in an occlusal direction, the cavity should be shaped so that the inlay can also be inserted in the same direction. In a pulpless tooth a smaller sized inlay can be used and anchored in the root-canal with a post, as shown in Fig. 613. Thus

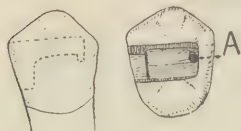


FIG. 614.

anchored an inlay furnishes a most reliable support. The post or pins should be paralleled to the other abutments the same as the inlays are, to permit insertion in an occlusal direction.

Bicusps and Molars.—For these teeth various shaped inlays are used as a retaining abutment. The approximo-occlusal and the occlusal are the forms generally applied. To both these forms, especially the occlusal in cases with vital pulps, one to four small pins should be inserted for the reason that an inlay used as a retaining abutment

must withstand a stress not required in a merely restorative operation. When the tooth is pulpless one inserted pin of proper size is sufficient.

In teeth with vital pulps, the anchorage cavity should be extended well across the occlusal surface, as shown in Fig. 614 (a bicuspid), and Fig. 615 (a molar). The cavity should be cut as deep as the presence of the pulp will properly permit. Pins may be inserted at points that will give stability and not impinge on the pulp, as shown at A, Fig. 614, also in Fig. 615 and Fig. 616 in section. In an anchorage inlay of the form shown in Fig. 617 pins inserted at the points C, D and E, will maintain it securely in position. In pulpless teeth the inlay cavity can be made smaller, as a large post can be used to anchor it.

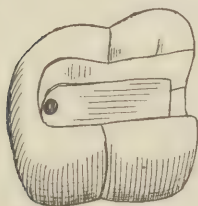


FIG. 615.

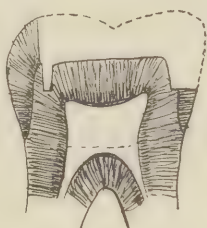


FIG. 616.

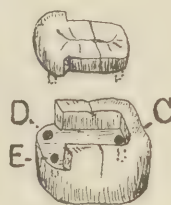


FIG. 617.

Pins are best made of iridio-platinum wire, gage Nos. 19 to 21, which has been rolled under a file. To secure adhesion of the pin to the gold in the casting, veneer the portion of the end to be extended into the inlay wax with a film of pure gold. This is easily done by perforating a pellet of gold foil with the end of the wire and holding it in a Bunsen flame.

The pin is heated and the shank veneered with adhesive wax to insure adhesion of the inlay wax.

Another Method.—When the inlay model is formed as above described, slightly warm and remove the pin or pins, by first placing a hot instrument against the end to loosen them, then chill the wax and remove the inlay model. In the place of each pin insert a carbon of the same gage slightly roughened to catch in the wax and with the extended end long enough to engage in the investment.

When the inlay has been cast and fitted to the cavity, the pin is adjusted to position, the hole in the gold being enlarged if necessary, attached with wax, the inlay removed, invested and the pin united with solder, using the smallest possible quantity; or the inlay may be cemented, the pin then introduced and cemented in the hole and inlay, the excess of the pin cut off, the end trimmed level and the end of the pin and inlay burnished and polished.

This latter method is advantageous when it is desirable to have a pin or pins at a tangent to avoid impingement on the pulp, especially in a case of bridge-work where the pins in two inlays require to be pointed in opposite directions, as shown in Fig. 618.

When pins are to be inserted in the cavity of an incisor or cuspid, the matrix method is often preferable, to permit adjustment of the pins by soldering them in position in the matrix with pure gold to secure accuracy of position in the finished inlay. The inlay can be finished either by investing the matrix and flowing in pure or 22-carat plate, or it can be shaped with wax and completed by the casting method. (See matrix gold inlays, Figs. 410, 444 and 466.)

Mesial-Occlusal-Distal Attachment.—This attachment is practically an inlay with an extension over the approximal surfaces. It is designed to act as an abutment for bridge-work.

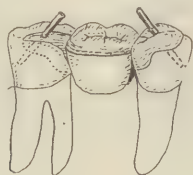


FIG. 618.

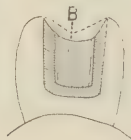


FIG. 619.

The tooth generally is best first trimmed on the approximal sides with a slight slant to the line of the cervical third. The occlusal surface is next uniformly removed one-thirty-second inch or more as conditions suggest, forming a depression (B, Fig. 619). This removal is next extended to and on the approximal sides, forming a small ledge. Occluding the teeth on a piece of wax, then holding the wax up to the light, will show any point requiring additional trimming at the occlusal or anchorage surface. (For Approximal Plate Extension Inlay see Fig. 428.)

The inlay attachment is especially applicable to cases of teeth which tip mesially, where the use of an inlay as an abutment frequently simplifies construction and permits the formation of a better occlusion, as shown in Fig. 620.

Bar Attachments.—This form of attachment, though seldom used since the advent of the cast inlay, is often a preferable method for the posterior teeth when conditions favor its application. A bar requires less removal of the occlusal surface to properly secure it, and is more easily removed from the cavity without mutilation than an inlay, when circumstances require it. For stability, as compared to an inlay, it is fully equal to the requirements when properly formed and inserted.

Construction.—Enough tooth structure is removed to place the bar, as shown in section in Fig. 621. Fig. 622 illustrates the mesial side, showing the dovetail form of cavity. The wire forming the bar is given the triangular shape illustrated and about the width of the orifice of the cavity. The bar is made of heavy iridio-platinum wire, or it may be formed of three wires, gage No. 20, arranged in triangular form, as seen in Fig. 622, the wires being soldered together with pure gold. This



FIG. 620.

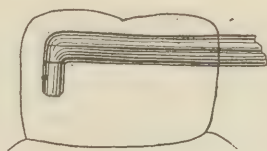


FIG. 621.

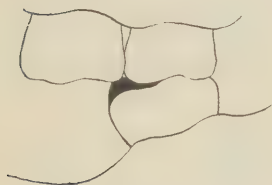


FIG. 622.

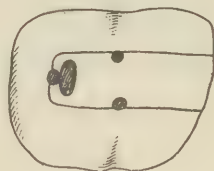


FIG. 623.

triangular shaped bar, when fastened with filling materials in the dovetail cavity in the tooth, with the right-angled point on its end additionally anchored in the distal hole, is secured in a manner that can be relied upon.

The bar is fixed in the cavity and slot with amalgam, and its position is secured against disturbance while the amalgam is setting, by a few pellets of gold foil condensed in two or three pits drilled in the tooth structure on each side of the bar, just before the amalgam is placed at those points, as shown in Fig. 623. The amalgam should be used soft, so that the bar can be imbedded in it. The surplus mercury is then worked out by compression with pellets of cotton. The triangular shape of the cavity and of the bar permits the amalgam to lock the bar securely.

CHAPTER V

BRIDGE CONSTRUCTION ON TOOTH ABUTMENTS AND PIERS WITH VITAL PULPS

Recent scientific investigation of the subject of focal infection caused by pulpless teeth, and the serious pathological conditions in many cases traced as directly attributable thereto, has demonstrated to the dental profession the importance of *pulp conservation in all classes of operations*.

In the preparation of vital teeth as supports for bridge-work many methods require an extensive removal of the enamel and of the dentin. Proportionate to the area of enamel removed, and more especially of dentin, is calcification of the pulp induced. Calcification of the pulp

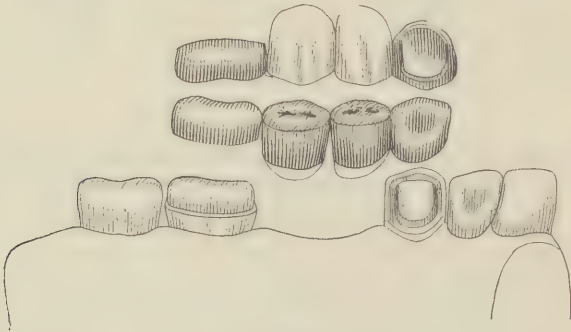


FIG. 624.

lessens it in size and impairs its function more or less. Extensive progressive calcification frequently results in complete calcification and obliteration of the pulp. Consequently, those forms of attachments suitable for use in fixed or removable bridge-work that require the least *alteration or mutilation of the coronal section of a vital tooth are the most favorably considered*.

For retaining attachments in fixed bridge-work various methods can be practiced that do not necessitate pulp extirpation. Of this class as here mentioned or described, those demanding the removal of the smallest quantity of tooth structure can be enumerated first as follows:

All-gold cap-crowns made in sections and seamless gold crowns stamped on a metal die of the trimmed natural crown.

Open-face all-gold cap-crowns (Figs. 589 to 593).

Pin inlay attachment (Figs. 607 to 610).

Inlay and bar attachments (Figs. 612 and 614 to 623).

Carmichael attachments (Figs. 599 to 605).

The typical case described in Fig. 517, is here shown constructed with a Carmichael attachment on the cuspid and a cast partial cap-crown on the molar. Fig. 624.

The attachments are made, placed in position on the abutments and an impression and bite taken with plaster that will remove the attachments in position. A model and articulating model are then run and mounted on an articulator and the remainder of the construction conducted as described in Part IV, Chapter I.

All-gold cap and open-face crowns, also inlay and bar attachments that likewise permit pulp conservation, as has been described, may be used as conditions suggest.

CHAPTER VI

PORCELAIN CROWN AND SANITARY BRIDGE-WORK

Porcelain Crown (Detached-post) Bridge-work.—The construction of bridge-work with a display of gold visible when the patient is talking or laughing, is very objectionable to many for esthetic reasons and the necessity for it frequently questioned by patients.

The objectionable display of gold in these cases is mostly located at the buccal cusps of the superior bicuspid, the incisal tips of the inferior anterior teeth, and the occlusal surfaces of the inferior bicuspid and molars.

These objectionable features prompted the application of detached-post crown teeth to such cases, and the manufacture of special forms of teeth. Besides their cosmetic effect, other advantages are claimed for their use, viz. (a) As the porcelain is removed from the work in soldering operations, the risk of fracture and change of shade is eliminated. (b) They are replaceable in case of fracture in use.¹

In the use of detached-post crowns as pontics for bridges, the backings or supports which are joined together to form the bridge must either rest directly on the gum or leave only a shallow V-shaped space which cannot be termed self-cleansing as well as that which is made with the ordinary porcelain facings.

The S. S. White, Dentsply and Ash Detached-post and Tube Crowns, also diatoric teeth are used in this style of work. Detached-post crowns and diatoric teeth, when used for abutment crowns, are ground, fitted and backed as described in "Detached-post Collar Crowns," (see page 212) with the addition that on the sides of the crowns approximal to the bridge a slot is ground, into which *the backing* on the base and lingual side is extended and burnished.

This side flange to the backing should be reinforced with hard solder or, when a cast backing is used, the flange should be made proportionately strong, as shown in Fig. 625, which illustrates a porcelain cuspid crown ground and backed. In the case of pontics the flange should

¹ In the use of all forms of replaceable teeth, the number and shade should be recorded with the name of the patient, as it simplifies the procuring of an exact duplicate.

extend up on both sides of the tooth as shown in Fig. 626. Fig. 627 is a bridge supporting a lateral.

In the construction of a bridge the base of a pontic when fitted should be ground enough to provide room for the backing, also to correspond to the surface of the model. When fitted on the model, the further work is simplified by supporting the pontics with wax in exact position on their lingual side and covering their labial or buccal side with a removable plaster matrix, to permit their removal and replacement. The pontics and all wax present on them and on the surface of the model are then removed. Cover the space between the

abutments with tin foil and vaselin its surface, to prevent further adhesion of the wax in the adjustment. Replace the pontics in the matrix to ascertain if there is sufficient space for the backings; if not,



FIG. 625.



FIG. 626.



FIG. 627.

provide it by trimming the porcelain. Back the pontics, adjust them in position, and cement the backings and cusps of the crowns with wax. Insert a piece of wire lengthwise in the wax to act as a brace (see Fig. 533). Chill the wax, detach the plaster matrix and remove the porcelain crowns and pontics from the backings. Examine and fill in with wax any vacant places between the backings. Again chill the wax, carefully remove wax and caps, and invest in the manner shown in Fig. 628. In soldering, all the joints between pontics and abutments should be carefully united, and the base formed by the surface of the backings reinforced sufficiently to reliably sustain the strain that will be exerted on it in occlusion. When the bridge is properly finished, the porcelain teeth are cemented in position.

When a bridge includes two or more pontics, an advisable plan is to remove two at a time from the matrix and solder the backings together. When the several pontics are united, they are waxed

fast to the abutments, removed and soldered to them. In this way, warping of the backing is avoided which, if it occurs, prevents the porcelain from fitting into place and is often very difficult to remedy. Fig. 629 shows bridges with porcelain crowns.

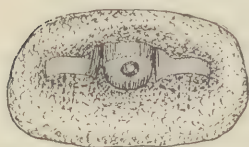


FIG. 628.

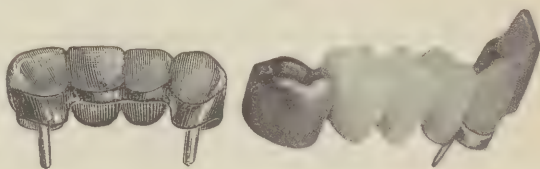


FIG. 629.

Casting Method.—The bases of the porcelain pontics may be cast separately (see page 298) and soldered together or cast in one piece and then united to the abutments.

Cast Sanitary Bridge.—To illustrate this method, we will take the case illustrated in Fig. 630, consisting of bicuspid and molar pontics



FIG. 630.

supported by gold crowns on the first bicuspid and second molar. The space between the crowns on the model of the case is filled in with plaster as a support, as shown at A, Fig. 631, and the surface of the plaster at the occlusal side is given a concave form, to impart a corresponding oval curve to the surface of the wax.

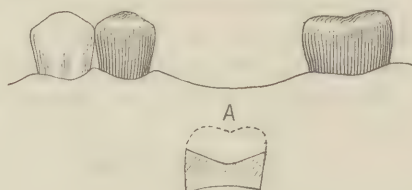


FIG. 631.

The surface of the support is varnished and then lubricated to prevent adhesion of the wax. The wax for the casting model is placed on the support between the crowns and the antagonizing teeth occluded. The wax model is then chilled, trimmed, shaped, removed and cast. The cast gold pontics are waxed in position to the abutment crowns, all removed and abutment crowns and pontics united.

The curved surface of the base of the pontics permits it to be more easily reached and cleaned by the tooth-brush than a flat surface. Fig. 632 shows the completed bridge.

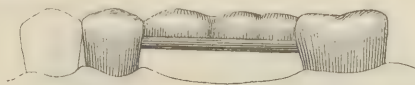


FIG. 632.

Sanitary Porcelain and Gold Bridge

In this style, in contradistinction to the preceding method, the coronal section of the absent teeth is restored entirely of polished, or better still, glazed porcelain.



FIG. 633.

As the surface of porcelain is not affected by the secretions and as deposits cannot well adhere to its surface, it is as near being sanitary as a material as possible. A bridge of this form is seen in Fig. 633.

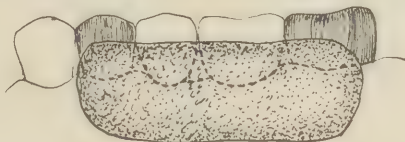


FIG. 634.

Either detached-post crowns or English tube teeth are ground and fitted as pontics and covered on the buccal side with a plaster matrix, as seen in Fig. 634. The holes in the center of the porcelain, when detached-post crowns are used, are drilled through to the occlusal surface, and at the cervical end or base the holes are closed by baking into them porcelain body. A high-fusing body should be used so that the heat required to fuse it will be sufficient to re-gloss the ground surface of the porcelain. The occlusal surfaces are then ground down so as to provide sufficient space for the thick cusp-caps, as illustrated in

Fig. 635. The cusp-caps are cast with posts extended into the holes in the pontics, or the posts are afterwards inserted and soldered. The cusp-caps are adjusted in position, and the ends cemented to the abutments with wax, and the bridge removed. The porcelain pontics are



FIG. 635.

removed from the cusp-caps (Fig. 636, in section), the bridge invested and the parts soldered together. The bridge is then trimmed and polished and the porcelain pontics cemented in position. The bridge then appears as shown in Fig. 633.

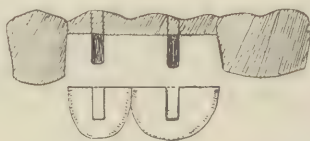


FIG. 636.

The cervical sections or bases of upper pontics are best reduced in size and given a surface approximating that of the shape of the gingival border and on the mandible more of an oval form, as seen in section in Fig. 636. To avoid exposure of metal, and for esthetic reasons,



FIG. 637.

especially on superior pontics, the cusp or metallic portion and the porcelain can be shaped as indicated in Fig. 637.

Incisors and Cuspids.—Fig. 638 illustrates the method of replacement of a recently extracted lateral, with a porcelain root pontic. Fig. 639 shows the replacement of a central and a recently extracted lateral. In this later case three-pin inlays were made for the central and cuspid. A wax bite was first taken and then a plaster impression that removed the inlays in position. Models were made and teeth selected. The base of the central was shaped as shown in Fig. 639 with porcelain and then backed with gold or platinum. In these

cases the laterals were made with porcelain roots that extended into the membrane of the socket one-fourth to one-third the length of the natural root.

If the denture is not inserted immediately after the extraction of the lateral the recess for the porcelain root can be packed with iodoform

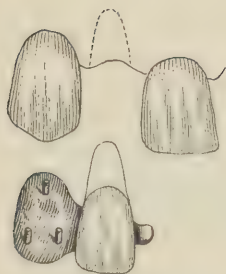


FIG. 638.

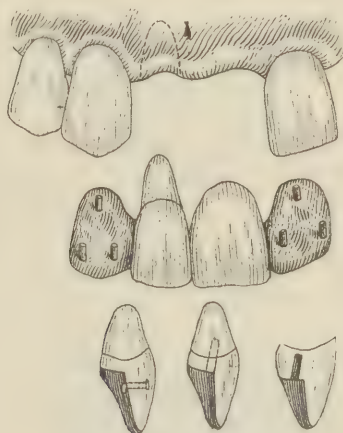


FIG. 639.

gauzé until the denture is inserted. The porcelain forming the base of a pontic and especially a root should have a glazed surface. This can be given by first polishing the surface as much as possible by the usual methods and then baking in the furnace at a temperature of at least 2300° . The gloss-like surface so imparted to the porcelain renders its presence benign to the tissues and capable of resisting infection. Under such conditions consequently the membrane hugs closely around the porcelain root.

CHAPTER VII

EXTENSION BRIDGES

The term "Extension" is applied to bridges chiefly or entirely supported by one abutment. In relation to the anterior teeth, it means attaching a pontic to an artificial crown, or other form of retaining abutment to replace an adjoining absent tooth, with or without a lug resting on an adjoining tooth as a supporting abutment. A bridge of this style when it replaces two or three posterior teeth is formed by using two of the anterior teeth as an abutment, and extending the pontic teeth from it, suspended, or on a saddle.

A saddle is an oval-shaped gold or platinum plate of the form of the alveolar ridge, placed under the extension pontics for them to rest on and obtain alveolar support to resist direct and lateral stress in occlusion. Although a most serviceable adjunct to a removable bridge, its use has been condemned and dispensed with in fixed bridge-work, as being insanitary. When a metallic base is applied under a pontic tooth, it should not exceed the size of the base of the pontic and be of a form that will permit the passage of floss silk between it and the surface of the gum for cleanliness and the health of the membrane. While such a base—sometimes incorrectly termed a saddle—may slightly aid to steady a pontic, it furnishes no material alveolar support.

Governing Mechanical Principles.—In extension bridge-work, the portion that constitutes the bridge exerts on the abutment, in resisting the force of occlusion, an action like that of a lever. This principle must receive consideration in the employment of this form of bridge. A lug support or supporting abutment on the extended end, if attainable, should always be applied even to one tooth. More than one tooth should not be extended from an abutment without such support. When two approximal crowns support an extension bicuspid or molar bridge pontic, occlusal force on the pontic is counterbalanced by the resistance of the further anchorage crown from the bridge, the pressure on which is in a line from the socket occlusally; the crown approximal to the pontic acting as a fulcrum the force on which is in the direction of the apex of the root. The occlusal surface of the pontic

should be narrower from buccal to lingual side than the natural tooth, to offer less occlusal surface to the antagonizing teeth, between which and the pontic tooth there should be a space of about one-sixteenth of an

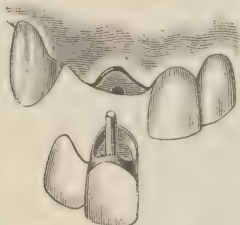


FIG. 640.

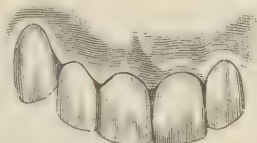


FIG. 641.

inch. In fact, such an extension pontic should be inserted principally for appearance and not for actual use.

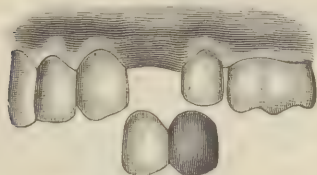


FIG. 642.

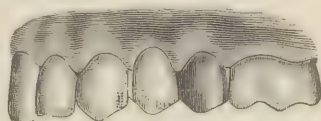


FIG. 643.

Construction.—The abutment is first constructed. If it consists of two crowns they are soldered together. An articulation and impression are taken which will remove the abutment in position, and models are made. The extension pontic or pontics are then fitted to position and soldered to the abutment. Figs. 640, 641, 642 and 643 show small extension bridges

Supporting Abutments

These consist in the use of lugs or other forms of supports that rest on a tooth, inlay or gold crown with or without a lock-pin but which are not cemented to them. A supporting abutment permits a slight vibration of a bridge in mastication, which is termed by some writers "*Movement in Function*" as it mitigates the direct strain. Such dentures are practically cantilever bridges.

Fig. 644 illustrates a case with a lug resting on a cuspid. A lug support is formed as follows: When the pontics are mounted on the model ready for investment, adapt on the model of the inlay filling or

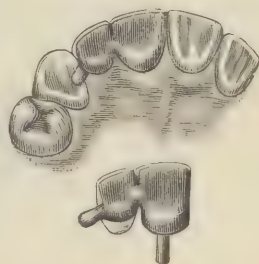


FIG. 644.

tooth where the lug is to rest, a piece of thin platinum, gage No. 36 to 38. Place on the surface of the platinum, when adjusted, a still narrower piece of gold clasp plate. Wax them in position to the pontic and invest. The projecting ends of the platinum and gold plate should be long enough to extend entirely across the tooth over on the adjoining one, to furnish a means of retaining the metal in position in the investment during soldering. The wax should cover only a little more than the portion of the metal to form the lug when soldered. In finishing

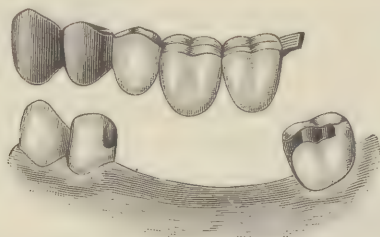


FIG. 645.

the surplus metal is cut off and the lug reduced so as to extend not quite to the edge of the inlay or filling it rests on. Sometimes in the case of an incisor, a lug is allowed to rest directly on the lingual side of the adjoining tooth as shown in Fig. 644. A lug so applied should be reduced in size and the edge slightly rounded so that floss-silk may be freely passed under it, which should be done at least twice daily. In the case illustrated in Figs. 645 and 646, the lug rests with the end curved in a countersunk amalgam filling.



FIG. 646.

A Lug with Lock Pin.—This consists in addition to a lug of a pin that anchors in, but is not cemented in the inlay or filling. For this purpose a gold inlay or amalgam filling is inserted in a deep approximal-occlusal cavity formed as illustrated in Fig. 647, which represents a typical case. The filling or inlay is slightly countersunk and a hole is drilled in the center about one-sixteenth of an inch in depth, large enough to freely receive an iridio-platinum pin of about gage No. 16. A disk of platinum, gage No. 36, large enough to cover the filling, is

adapted to its surface and perforated over the orifice of the hole. The point of the pin is inserted in position through the hole in the platinum, into the hole in the amalgam, attached with wax, removed, invested and connected to the platinum with a small quantity of pure gold. The lug is trimmed and fitted in the mouth, the bridge inserted and the lug

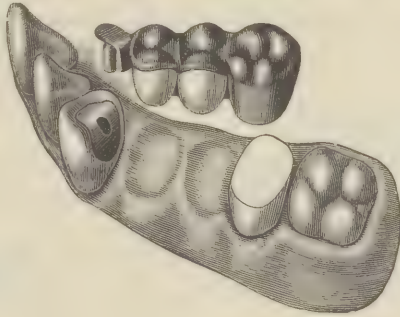


FIG. 647.

attached with wax to the bridge. Bridge and lug are removed, invested, united and the lug reinforced with solder and a narrow strip of gold clasp plate.

A supporting abutment as constructed for removable bridge-work and described in Part V, page 394, may in some cases be used for a fixed bridge.

CHAPTER VIII

BRIDGE-WORK AND SPLINTING IN CASES OF PYORRHEA ALVEOLARIS

THE PLATE AND PIN ATTACHMENT—USE OF CONNECTING COLLARS— POSTERIOR TEETH—BICUSPIDS AND MOLARS

In cases of pyorrhea alveolaris, when the teeth are loose, connecting them with bridge-work or a splint steadies them in their sockets and consequently permits more effective treatment.

The method here described relates to teeth not affected, or only slightly so by decay.

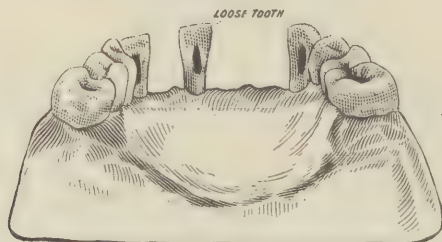


FIG. 648.

The Plate and Pin Attachment.—This attachment may occasionally be applied in cases of pyorrhea alveolaris. By its use loosened teeth can be joined together and supported without exposure of metal.

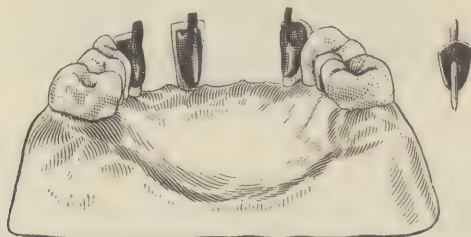


FIG. 649.

In such cases, when the tooth has a vital pulp, a two- or three-pin inlay is used, and when the tooth is pulpless a one-pin. The pins and plates are made and fitted to each tooth, the ends of the pins being left protruding from the plates. An impression is taken, removing the

plates and pins in position. They are next invested and soldered together.

An intervening absent tooth or teeth may be supported between sections of the plates.

The method is especially applicable in cases involving the lower front teeth. Fig. 648 illustrates such a case with the teeth prepared, pulps having been removed; Fig. 649 the plates with their projecting posts in position; Fig. 650 the constructed denture, and Figs. 651 and 652 the denture in position on the model.¹



FIG. 650.

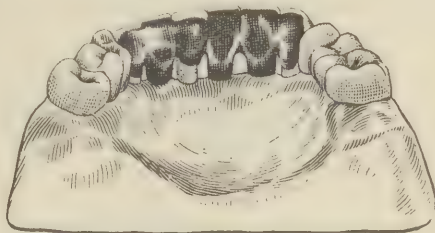


FIG. 651.

Use of Connecting Collars.—Fig. 653 illustrates and explains a method of replacing an incisor and supporting the adjoining loosened teeth with successive cemented connecting collars of gold, in cases of pyorrhea alveolaris. This method does not require removal of the pulp. For the application of such collars, the teeth require to be trimmed the thickness of the plate used. The collars may be formed of a strip of pure gold plate about gage 32 to 33, or platinum, gage Nos. 36

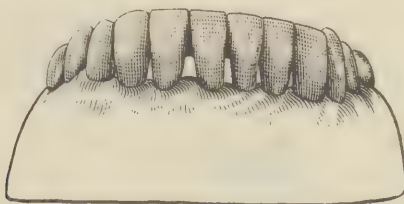


FIG. 652.

to 38, by bending and fitting the strips to the form of any two teeth, in the shape shown at A, Fig. 654. This leaves but one thickness of plate between the teeth. An additional loop can then be added, as shown at B, for one adjoining tooth. The soldering may be done quickly with a Bunsen burner without investing. Parts of the loops which demand it should be slit and lapped to allow the plate to be adapted closely to the surface of the tooth.

¹ Dr. D. D. Smith.

The bands of metal should be placed toward the incisal section of the teeth, leaving the interproximal spaces between the teeth entirely free. The cementation can be done with zinc phosphate or silver chlorid cement, or if removal is contemplated, with gutta-percha cement. A fusible metal die will assist the operation before fitting the collar in the mouth. To form the metal model, take a plaster impression in a sectional impression cup, and fill with fusible metal under pressure. (See page 443.) Cut the spaces between the teeth on the model with a saw of the same gage as the gold or platinum plate to be used and smooth with polishing strips or disks.



FIG. 653.



FIG. 654.

Posterior Teeth

Bicuspid and Molars.—These teeth may be bridged or splinted by the use of inlays, bars or short caps or plates. Pins should be inserted in the mesial and distal ends of an inlay or, if pulpless, a single post can be extended into the pulp-canal. Sufficient of the natural crown and of the antagonizing teeth must be removed to allow ample space for the intervening metal applied.

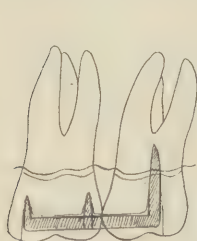


FIG. 655.

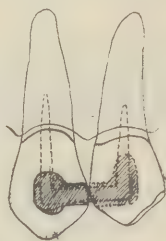


FIG. 656.

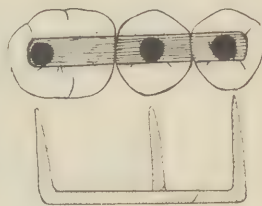


FIG. 657.

Fig. 655 shows in section a molar with living pulp in which is inserted a bar or inlay, with two pins in the line of the sulci, and the inlay or bar extended into an adjoining pulpless molar. Fig. 656 represents in section, viewed from the lingual side, a small plate and pin attachment on a pulpless cuspid and bicuspid.

Fig. 657 and 658 illustrate in section pulpless bicuspid and molars prepared with an iridio-platinum bar, with pins to be inserted and

anchored in them with amalgam. Veneering the bar with a film of pure gold by melting pellets of gold foil over it with a blowpipe, then rolling it under a file, will effect a better adhesion of the amalgam to the bar.

In the formation and adjustment of these appliances, close adaptation of the metal to the surface of the teeth and avoidance of pockets should be observed. The incisal edges and cusps of affected teeth

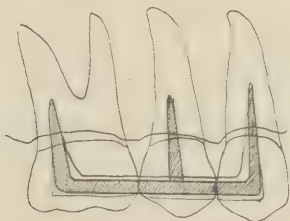


FIG. 658.



FIG. 659.

should be trimmed and shortened so that while the teeth occlude evenly, the cusps only touch their antagonizing teeth in the lateral movements of the jaw. The object is to retain direct pressure but do away with lateral strain (See Fig. 659). Constant care regarding cleanliness by the frequent and regular practice of prophylactic measures is required of the patient. See Chapter XII, The Hygienic Condition of the Mouth as Affected by Fixed Bridge-work.

CHAPTER IX

REPAIR AND REMOVAL OF CROWN- AND BRIDGE-WORK

The fracture of a porcelain facing on a permanently attached bridge is an annoying incident for both patient and dentist. It is usually attributable to failure to properly protect the incisal edge or occlusal surface of the porcelain with metal, a precaution rendered necessary by the rigid character of the resistance offered the antagonizing teeth through the abutments, or by exposure of the porcelain in time through loss by attrition of the metal protecting it. In most cases the porcelain can be replaced without the removal of the bridge, but the attachment is seldom as reliable as in the original piece.

The Ordinary Method.—The following is the method commonly adopted with incisors or cuspids: The pins of the broken facings are cut off, the surface of the backings trimmed level, and a suitable platinum long-pin facing selected. Mark the position of the pins of the new facing on the backing by drying, heating and flowing over its surface a film of wax, then with small pliers place the facing in position, and press the pins in the wax; or place a little rouge and oil on the end of the pins and mark the backing with them. At the points marked, drill holes in the backing to receive the pins of the new facing, countersinking the holes at the lingual side. After the backing is drilled, grind the porcelain to fit it as perfectly as possible, place in position and grind off the pins so that they protrude enough to form a head when riveted.

If a suitable long-pin platinum tooth is not procurable, the short pins of an ordinary tooth can be lengthened by bending a piece of platinum wire in the form of a semicircle and soldering its ends to the ends of the pins with pure gold. The wire is then cut in the center and the lengthened pins trimmed as required.

The pins are riveted on the lingual side into the countersunk holes of the backing. The riveting should be done with punch forceps having a large punch (Fig. 660), the porcelain facing being protected by a piece of lead placed against the labial aspect, or by the use of a matrix formed of impression compound softened and then chilled. The heads of the pins should be burnished smooth with a revolving burnisher.

In case of fracture of the porcelain facing of a bicuspid crown or pontic with a thick gold backing, a corresponding facing with very long pins is selected and ground to fit, and holes in proper position drilled in the gold, to receive the full length of the pins. Roughen the pins a little with a sharp instrument and cement pins and facing to the gold. Should the holes extend through the gold at the lingual side, the opening should be slightly countersunk and filled with gold or amalgam.

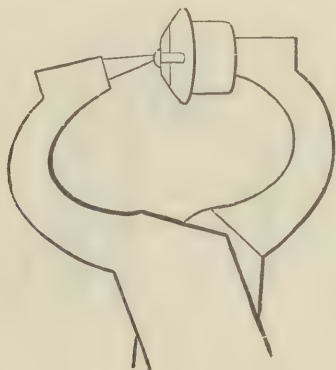


FIG. 660.

Any gold present to protect the occluding edge of the porcelain should be burnished against its surface.

The Improved Bryant Method

The technic of the Bryant bridge-repair method, as recently modified, to assure easier, more accurate work, and greater strength is thus described:

Clip off the pins from the bridge and grind to a flat surface, and cover the surface with a film of wax. Hold the new facing in exact position and press the pins through the film of wax. With a pointed instrument and hand mallet center-punch the position of the pins as shown in the wax, thus giving a starting point for the drill No. 101, (Fig. 661), with which drill two holes through the backing to receive the pins of the new facing. Next grind the facing to exactly fit the surface of the backing, and with counterbore No. 10 enlarge the holes in the backing.

Using reamer No. 3A, from the lingual side, enlarge the lingual opening of the holes, taking care to stop this operation just before the end of the reamer is flush with the labial surface of the backing. Care-

fully cut a shallow thread on the tooth pins with die No. 1 and follow with die No. 2 to complete the thread to full depth. See that the pins are threaded their full length close up to the porcelain.

Cover the lingual surface of the facing with cement or gutta-percha, keeping the pins clean, and press to place. Use nut-holder No. 6 to carry the nuts No. 5 to place over the threaded pins, and with nut-

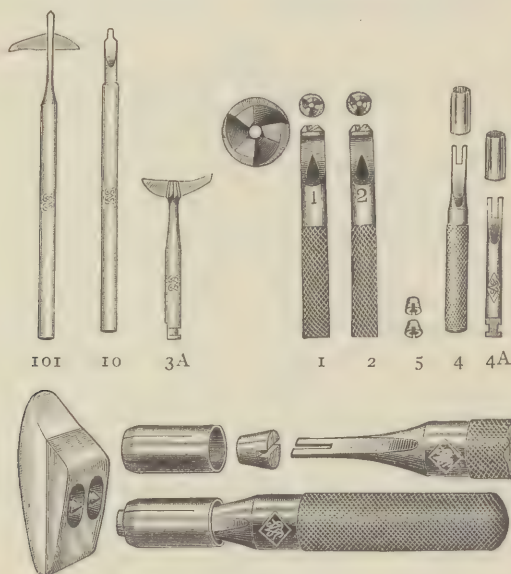


FIG. 661.

driver No. 4 screw alternately to seat. The nuts should be tightened sufficiently to bring the facing and backing into contact, but without excessive force, which might cause fracture of the porcelain.

If the nut or pin extend beyond the backing, grind off flush and polish. If below the surface of the backing, fill in with Corona gold or gold foil.

Countersunk Pin-Hole Method.—This method is to be used only when the pins remain intact in the backing. Remove all the fractured facing. Select a facing of the same make and mold; if not procurable, one of the same size, thickness of porcelain and location of pins. Cut the pins off close to the porcelain; drill out the portion of the pins left and enlarge and slightly countersink the holes with carborundum paste and a copper or steel drill,¹ so that the pins in the backing shall enter

¹ Use one of the drills of the set sold for drilling holes in porcelain teeth to insert imitation gold filling.

the holes in the porcelain facing easily and permit the new facing to come to place, as shown in Fig. 662. To correct any discrepancies in conformation between the surface of the gold backing and the facing, paint the surface of the gold with a coat of rouge and oil and press the facing against it. The rouge will mark on the porcelain the exact spot to remove. When fitted by this method and cemented with zinc oxyphosphate or silicate cement, a very reliable replacement of the facing is effected.

To Repair with a Dimelow Facing.—A Dimelow facing may be utilized to replace a fractured facing of the ordinary type when the pins are broken from the backing. Clear the backing of fractured porcelain and pins. Select a Dimelow facing (See Fig. 569) and grind it to position against the backing. Dry and heat the backing and melt a little wax over the part that corresponds to the position of the pin-holes in the facing. Moisten the facing and press it firmly against the wax. On removal, the position for the pin-holes through the backing will be indicated by two raised points of wax, formed by the holes in the facing. With a spear-shape drill corresponding in size to the holes in the porcelain, drill two holes through the backing in the places indicated by the wax points in a linguo-gingival direction, in a line with the holes in the facing. Follow the drill with a tap, and screw into the holes two threaded pins, and cement facing to pins and backing.¹

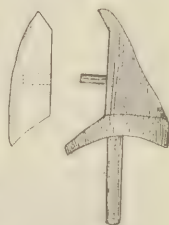


FIG. 662.



FIG. 663.

Ash's Repair Facings.—Fig. 663 illustrates these facings. They are made with a slot for the ends of the pins of the broken porcelain facing to fit into and be connected. As the position of the pins usually varies, the replacement may call for considerable fitting. This can be simplified as follows: After removing all remnants of the broken facing and exposing the pins, place a little cement around the shanks of the pins to even them with the heads, then take an impression of the backing and pins with impression compound, and form an amalgam replica or model (Fig. 664). Place some white gutta-percha on the backing in the place of the porcelain to represent the facing and dismiss the

¹ An especially prepared outfit is manufactured and sold for repairing with the Dimelow facing.

patient. By the next engagement, grind and fit an Ash porcelain facing to the amalgam model, a much easier task than fitting it to the backing in the mouth. Cement facing in position with silicate cement.

Inlay Method.—This method is applicable if the pins are still in the backing. Select porcelain facing, if possible of the same mold as the fractured facing. Remove the pins of the facing, and using as a model an amalgam replica made as described in the preceding method (Fig. 664), grind down the facing to a veneer that will fit in position over the pins of the backing. Adapt by burnishing to the surface of the cavity of the backing that was occupied by the porcelain, a piece of 1/1000 platinum foil, as a matrix, and if necessary, by swaging the platinum to the amalgam die. Shape the platinum over the pins but

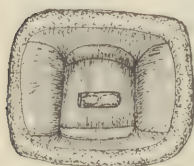


FIG. 664.

not against the sides so as to obstruct easy removal of the matrix. Fill the matrix with Close's porcelain body. Vibrate the body and absorb the moisture with blotting paper, then press the porcelain veneer on the surface and into the porcelain body to proper position. Remove the porcelain veneer so as to leave its impression in the porcelain body, then remove matrix and body from the

mold, place it on pulverized silex on a slab and give it a good biscuit bake.

Replace matrix in amalgam model, correct any warping incidental to the shrinkage in baking, add body and again place the veneer in position. Remove both together and give the fusing bake.

When the platinum matrix is removed from the body of porcelain, you have a porcelain facing the exact form of the cavity of the backing. The cavity or box in the porcelain that receives the pins may be slightly countersunk with an old wheel bur and carborundum powder. Roughen the cavo-surface of the porcelain and cement to place with silicate cement and burnish the incisal edge of the gold backing to the incisive edge of the porcelain.

Repair of an Incisor or Cuspid Gold-Backed Crown with a Detached-Post Crown.—Remove fractured porcelain and pins, grind and shape the gold backing and floor of the cap as nearly as possible to a form approximating that of a gold root-cap, with a post to receive a detached-post crown. Fig. 665 shows the relative comparison. Take an impression in compound; cut and shape a piece of coin silver the size of the trimmed post on the root-cap, insert the piece of coin silver in the impression of the post and make an amalgam die. Allow the amalgam to crystallize until the next day. Select a suitable detached-post crown. As the post on the cap will be found a little back of the

line of the hole in the porcelain in a lingual direction, remove with fissure-shaped carborundum points enough porcelain to freely admit the post. Should the carborundum point go through the porcelain in making the space for the post, trim off a little of the end of the post and bake over the hole a thin layer of Close, Jenkins or other suitable porcelain body. If necessary, build the applied body a little above the surface of the porcelain of the crown, as shown in section at point A, Fig. 666. The post is notched and the crown cemented on with silicate or some equally hard cement, that will adhere to the porcelain and gold.

In suitable cases, this method gives very satisfactory results and is often equal in reliability to an entire new crowning operation.

Silicate Cement Facing Repair.—This cement can be used to replace a porcelain facing temporarily, in many cases for considerable time. When the metallic incisal edge of the backing or occlusal surface and the pins is present, repair work of considerable durability may be effected. The fractured porcelain having been removed, the backing is protected from moisture, and a mixture of the silicate cement of the proper shade applied and shaped with a spatula to the form of the former porcelain facing. When the cement has set it is shaped in detail. A matrix approximating the facing in form may be used to condense and shape the cement when setting.



FIG. 666.

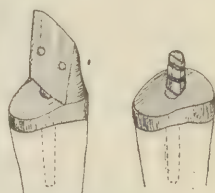


FIG. 665.

Advantages of Detachable Bridge-Work.—If the character of the break in a porcelain facing will not permit repair in the mouth, the bridge must be removed, repaired and reinserted. Under such circumstances, the advantages of a detachable form of bridge are evident. The additional time required to construct

cases of bridge-work that will properly admit of being made detachable and cemented with gutta-percha or gutta-percha cement combined with zinc oxyphosphate is not as much as that which would be consumed in the construction of the same work with replaceable porcelain facings.

Removal of Crowns or Bridges Cemented with Oxyphosphate or Similar Cements.—When it is necessary to remove an artificial incisor or cuspid crown, whether inserted singly or as a support for a bridge, it can be detached by grinding the gold and porcelain away at the lingual section over the post, which when exposed is severed, and the attach-

ment of the cement under the floor of the cap broken up, as shown at A, Fig. 667. In a case where the facing is fractured or absent, as illustrated in Fig. 668, the post may be more easily reached from the labial side (B). The collar may also be slit and bent aside, if found necessary. When a post of a crown is veneered with a film of gutta-percha previous to cementation, the removal of the post is easily effected.

In the case of an all-gold crown, usually the collar on one or both sides has to be divided and pried up from the root by first making a groove with a small vulcarbo disk; and then cutting the gold with a small bur or a sharp instrument. A crown-slitter, an instrument made for the purpose, will facilitate the operation (Fig. 669). In an all-gold crown on a very short posterior tooth, a large hole drilled in the occlusal surface will sometimes admit of removal of a sufficient quantity of the cement to enable the attachment to be loosened by prying upward. With care and patience in the operation of removing a gold

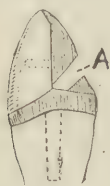


FIG. 667.

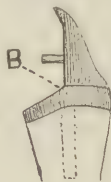


FIG. 668.

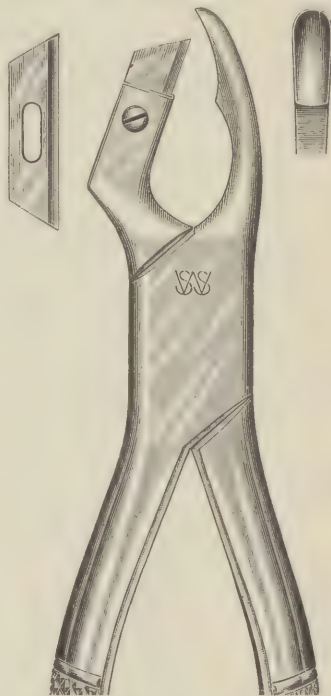


FIG. 669.

crown, it will often not be injured beyond repair, but usually the time spent in repairing, considering the result, suggests a new crown instead.

Removal of Post.—To remove a post, first drill away the cement around the post at the orifice and a short distance up the canal with the smallest size round-head bur, keeping the bur against the surface of the post. Next seize the end of the post with pliers and with a moderate amount of force carefully applied endeavor to remove it. If this does not succeed, use a post puller.

A Post Puller.—Fig. 670 illustrates the S. S. White post puller outfit. It consists of a straight (1) and right-angle (2) reamer to ream the end of a post and a screw stock (3) to cut a thread on the

reamed end. The screw socket of the puller is next screwed on the end of the post, the thumb-screw that lifts the socket is screwed down against the end of the root, and the socket of the post lifted incisally,

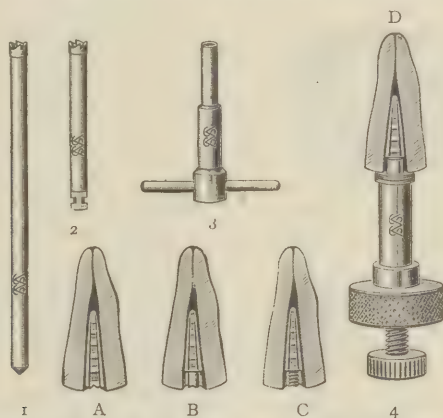


FIG. 670.—1, Trephine for direct and 2, Trephine for angle handpieces. 3, Screw-stock. 4, Post-extractor. A, B, C, D, Post and root at various stages of the operation.

removing the post. A rubber washer around the socket with a metal washer behind it against the body of the puller, gives the necessary bearing, equalizes the pressure and avoids fracture of the root by cushioning it.

Fig. 671 shows another style of post puller, called the "Little Giant," that can be quickly applied when the end of the post extends beyond the surface of the end of the root. The end of the post is seized between the large beaks of the puller by tightening them with a



FIG. 671.

FIG. 672.

screw and the shoulder is screwed down on the end of the root, lifting the post incisally.

Difficult Post Removal.—Some posts are so deeply inserted and firmly cemented that they cannot be safely removed with a post puller as ordinarily applied. In such cases a very small space should be cut around the post, removing any cement present and as little

dentin as possible, with the smallest sized round-head bur. A post puller can then usually be effectively applied.

When a post cannot be removed by any of the methods mentioned the only resource is to drill it out, a tedious operation and one requiring great care. In the upper section of the canal where the post cannot be seen while drilling, use a new sharp round-headed bur smaller in gage than the post. Apply the bur with a light steady pressure that will indicate when the bur is on the metal of the post, and when off of it in the dentin. By taking time and exercising patience, the post can be removed without material injury to the root. Smooth-sided drills with several small blades that cut only on the end, as shown in Fig. 672 may be used effectively to cut into the center of the post in the lower section of the canal.

Removal of Crowns or Bridges Cemented with Gutta-Percha Only, or Combined with Oxyphosphate.—In metallic collar or cap-crowns, *first slightly raise the edge of the collar.* Fig. 673 shows a crown-heater for cementation and removal of incisors and cuspids. It is to be moderately heated and applied as illustrated. Fig. 674 shows a small-sized crown-heater for general use. The membrane should be protected by spreading a napkin across the mouth over the lower lip. In using the form of heater shown in Fig. 674 heat it almost to a red heat,

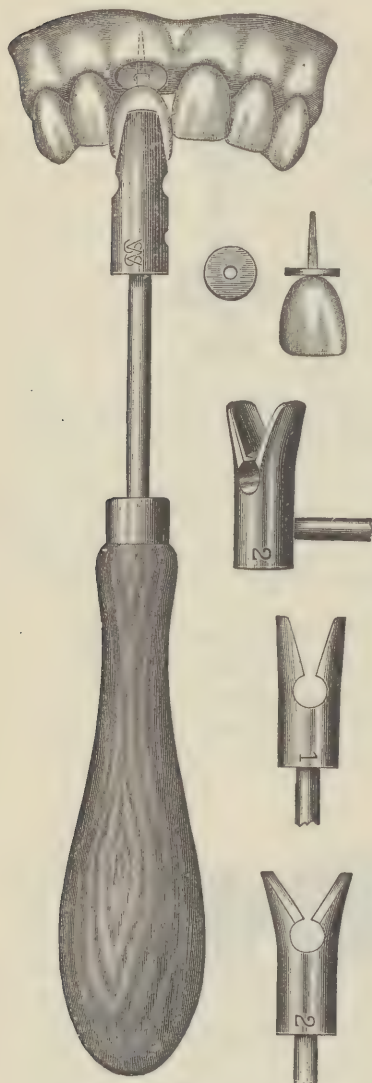


FIG. 673.

place a finger against the artificial crown and apply the crown-heater to the crown. For bicusps and molars, apply the crown-

heater to the occlusal surface and for incisors and cuspids at the lingual side toward the incisal edge. As the crown absorbs the heat, it is indicated by the finger. When the heat is raised as high as the finger can comfortably bear, the crown-heater should be removed for an instant to permit the crown to cool slightly, then again applied. In heating a crown, it is well to instruct the patient to raise the left hand should the heat become painful at any time. The application of the heat should be continued as directed for at least five or more minutes until the gutta-percha in all parts of the crown is thoroughly softened, which proceeds slowly owing to its contact with the natural crown or root. In bridge-work, as soon as the first crown is heated, instantly pass the crown-heater along the surface of the bridge to another crown or crowns and then back and forth on the surface of the bridge until all the attachments are uniformly heated. When this has been effected, start the bridge at one end and then at the other, or at both together, and lift it from position.



In miniature.
FIG. 674.

Repair of a Gold Collar Crown.—A hole or slit in a gold cap-crown is easily repaired, by first placing and pressing on the outer surface over and into the hole or slit soft adhesive wax, (W, Fig. 675). Next adapt a piece of platinum foil, PF, considerably larger than the aperture, over



FIG. 675.

it on the cavo-surface; when the slit or aperture extends to the edge of the collar, extend the foil well beyond the edge. Attach the foil to the wax placed in the aperture from the outside surface of the crown by placing a heated instrument against the surface of the foil inside the crown. The interior of the crown is next filled with investing material. The wax is washed off the outside of the crown, exposing the hole or slit, and solder is melted and flowed over the platinum and gold collar. The crown should be heated slowly to allow the investment to dry out thoroughly before the soldering is begun.

CHAPTER X

GENERAL APPLICATION OF FIXED CROWN- AND BRIDGE-WORK

The construction and general application of fixed bridge-work, as explained in the foregoing chapters, are additionally explained and illustrated in the following typical cases.

Central or Lateral Incisors, Cuspids or Bicuspids.—The restoration of a central or lateral is an operation that calls for the exercise of judgment and in some methods of procedure, tests the skill of the operator. When the other teeth are present, the subject of support involves the question of pulp preservation and the mutilation or excision

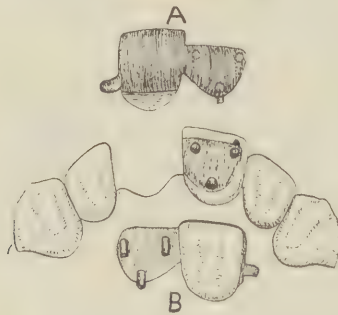


FIG. 676.

of one or both of the adjoining natural crowns. The condition of the adjoining teeth respecting freedom of the crowns from decay, whether vital or pulpless, health of the roots and contiguous membranes and occlusion, will suggest the most suitable method of procedure.

When a central is to be replaced and a normal condition of teeth and occlusion is present, the support preferably should be obtained by the adjoining central, or central and lateral combined, if possible without removal of the pulp. If the abutment tooth is favorable in form and occlusion, this may be done either by the use of the three-pin inlay or a Carmichael attachment on the central, with the aid of a lug resting on the lateral. The three-pin attachment is frequently suitable in the case of a central. Fig. 676 shows a typical case. A is the bridge viewed from the lingual side and B from the labial.

When the central is short, the incisal edge worn down by attrition so that the pontic will have to resist directly, or nearly so, the force of occlusion, the Carmichael attachment is preferable, as such an attach-

ment is comparatively stronger. Additionally a lug resting on the lateral or an inlay in the lateral is also advisable, as illustrated, viewed from the labial side in Fig. 677, or instead the use of another Carmichael attachment as a support, as shown in Fig. 678, lingual aspect.

If either the central or lateral is pulpless, an inlay or plate with a post extending partly up the pulp-canal is the preferable support, as shown in Fig. 679.

As removal of a pulp to form an attachment involves opacity and in time dis-

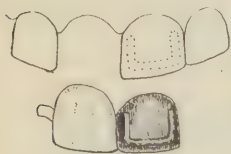


FIG. 677.



FIG. 678.

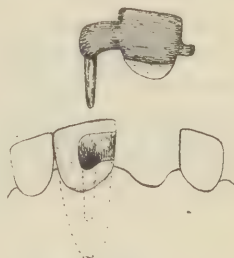


FIG. 679.

coloration of the tooth, with the liability of the subsequent development of pathological conditions, this operation should be avoided if possible especially in the case of young patients. In the case of patients over forty years of age discoloration from removal of the pulp need not be so seriously considered, but it will certainly occur to some extent in time, no matter how scientifically and skilfully the operation is performed. It is nevertheless a method that was formerly extensively practiced but not so much since the value of pulp conservation has become better understood. Many operators in such cases remove the pulps of both adjoining teeth to insure a more positive support and prevent spreading of the supporting teeth, also to avoid pressure on the pontic that would push it forward and twist the central on its axis when that alone is used as the abutment.

When a pulp is to be removed from an incisor for such a purpose, it should be done instantly by the use of local anesthesia or under nitrous oxid alone or combined with oxygen. The upper section of the root-canal can be sealed to stop all hemorrhage with a dressing of colorless essential oil, such as oil of myrtle. The rubber-dam should be applied, no saliva allowed to enter the canal and the dressing hermetically sealed with gutta-percha, covered, if necessary, with oxyphosphate. The dressing should be allowed to remain not more than two or three days. The rubber dam is then applied, the dressing removed, the canal washed with absolute alcohol and the foramen closed with gutta-percha and the remainder of the canal and cavity of the crown filled with absolutely white zinc oxychlorid. No further antiseptic

treatment than mentioned should be practiced, as the canal is not infected and is thus protected. In this manner the natural color of the tooth will be maintained to the greatest possible degree. Later drill out enough oxychlorid to admit the retaining post. Fig. 680 shows a case treated in this manner, the central and lateral being used as abutments. Fig. 681 illustrates a lateral and central supported by a central and cuspid.

Inferior incisors are seldom lost except by pyorrhea. In such a case, plates with pins, or collars may be used on the adjoining teeth, as is illustrated in Figs. 648 to 652. When an open-face crown is used as an abutment, the labial surface of the gold needs to be removed enough to avoid its exposure in the movement of the lips.



FIG. 680.



FIG. 681.

The pin-inlay method for single incisor replacement is described at page 316. The pulps of inferior incisors usually require to be removed for this method, but not in the case of a cuspid, when the size, shape and condition of the tooth will permit of the insertion of three pins.

Excision of the natural crown of the adjoining central and mounting a collar crown on the root simplifies the operation of restoration of either a central or lateral. When a central is disfigured or weakened with decay or fillings, this is the best method (Fig. 682) unless the case will permit the use of a gold jacket crown with a porcelain facing. (See page 192.)

A lateral can be supported in like manner by the adjoining central or cuspid in accordance with any of the methods described. As a rule, preference should be given the cuspid as a support for a lateral, unless the condition of the central suggests its utilization by being pulpless, or its appearance suggests that an artificial crown would be an improvement.

Fig. 683 shows the replacement of a recently extracted lateral incisor by the Sanitary Porcelain and Gold method. (See Fig. 633.)

The replacement of a superior incisor by an extension bar support from a bicuspid, as shown in Figs. 683 and 684 is not now favorably considered. In a few years the leverage exerted loosens the bicuspid. Preferably place an open-face cap with a pin or pins on the bicuspid,

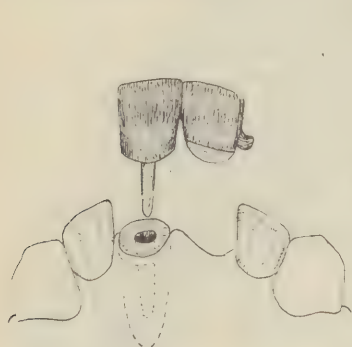


FIG. 682.

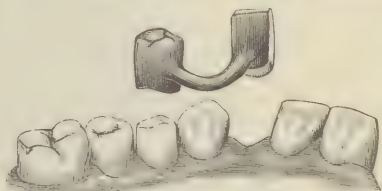


FIG. 683.

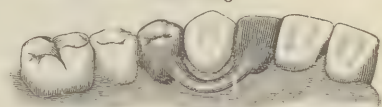


FIG. 684.

and extend a narrow iridio-platinum bar across the lingual side of the cuspid to support the lateral (Figs. 685 and 686). The cuspid in this way relieves the strain on the bicuspid. The surface of the enamel of the cuspid can be cleaned by daily passing floss silk under the bar.

The method of construction is as follows: An open-face crown is constructed for the bicuspid by one of the methods already described.



FIG. 685.

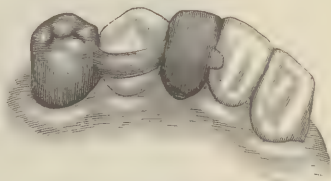


FIG. 686.

The crown is placed on the tooth, the pontic lateral fitted, properly backed and cemented in position with sticky wax, an impression taken and a model run of investment material. The model will show the crown and lateral in position. Place a narrow strip of platinum plate, gage No. 38, across the lingual side of the cuspid touching the gold cap

and backing of the lateral. Over the platinum place a still narrower piece of gold clasp plate, about gage No. 28, or a piece of half round wire, gage No. 14, wax the ends to the crown and lateral and hold it in position in the center with investing material. When the ends of platinum and plate or wire have been attached with solder to the crown and lateral, the investing material should be removed from the center

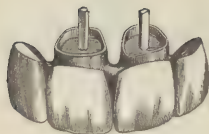


FIG. 687.

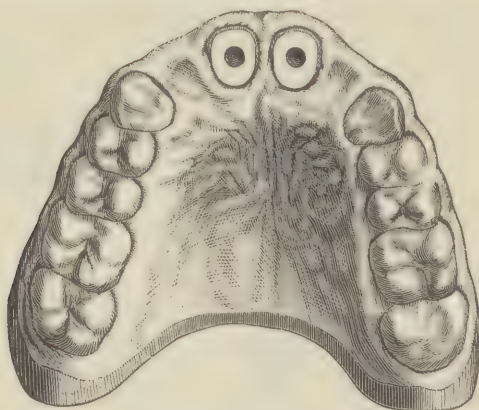


FIG. 688.

and the solder flowed across the piece forming the bar. This makes a bar with a surface of platinum resting against the tooth. In finishing it should be reduced in width as much as requirements for strength will permit.

Centrals, Laterals and Cuspids Combined.—Two laterals supported by two central crowns are shown in Figs. 687 and 688 and in position

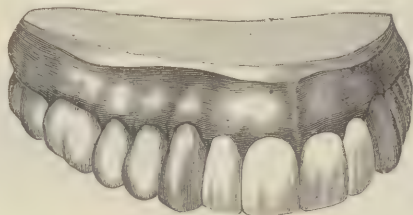


FIG. 689.

in 689. Lugs are best additionally formed on the laterals to rest on the cuspids. When approximal crowns are united to support bridge-work, as in this case, a free space should be preserved at the cervices between their respective collars to properly admit the gum septa.

Figs. 690 and 691 show a bridge of the incisors supported by two collar crowns on the cuspid roots.

Open-face cap-crowns may also be used in a case suitable for their application. Figs. 692, 693 and 694 illustrate a case with open-face

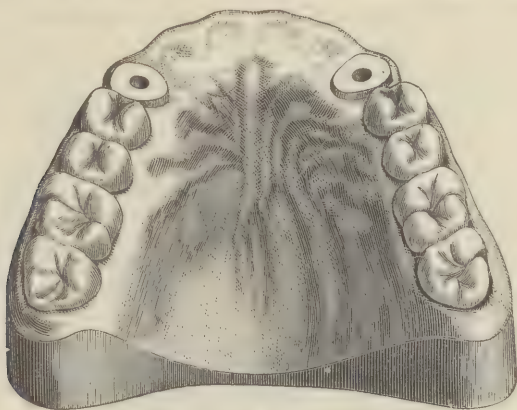


FIG. 690.



FIG. 691.



FIG. 693.

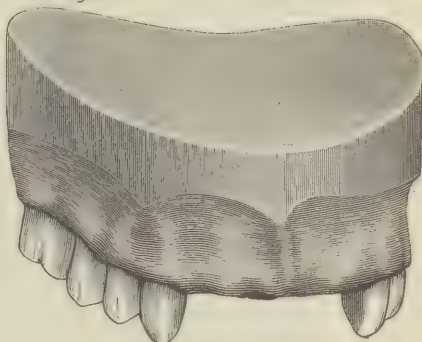


FIG. 692.

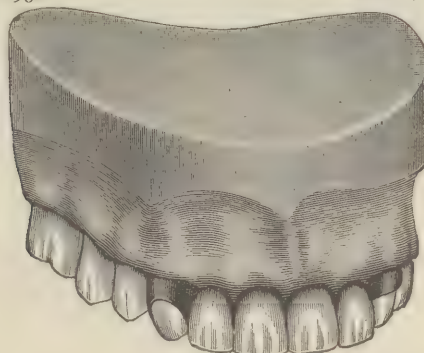


FIG. 694.

cap-crowns for supports. In the construction the best method is to form and fit the caps or crowns to the cuspids, remove them in a

plaster impression and "bite," make models and then bridge between the crowns with the incisors.

The edges of the labial section of collars of open-face crowns should be leveled and burnished close to the teeth. If properly done in a case where only the mere edge is visible in laughing, they will resemble cervical gold fillings. Inlays or bars extending from the cuspid crowns

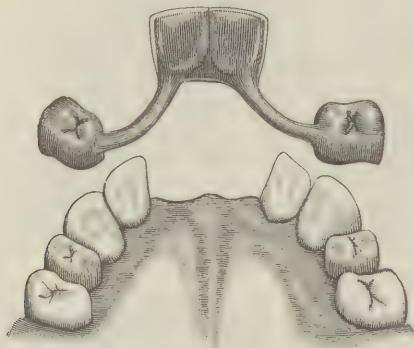


FIG. 695.

into the first bicuspid or lugs resting or anchored in inlays in the bicuspid as supporting attachments can be utilized as an additional anchorage should the occlusion of the anterior teeth indicate it.

Gutta-percha alone or in combination with zinc oxyphosphate or the silver chlorid cement is suggested for use in the cementation of some of these cases (see pages 260 and 264).

In the method shown in Figs. 695 and 696, for the insertion of two centrals, the leverage exerted on the bicuspid will in a few years certainly loosen them in their sockets. The addition of lugs placed on the distal sides of the central (pontics) resting on the laterals will, in a measure, relieve the stress, but will have a tendency to press the laterals

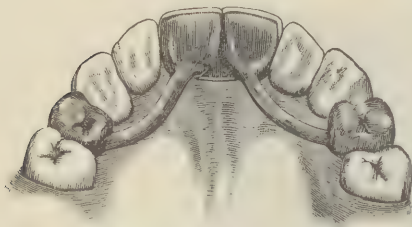


FIG. 696.

forward; consequently the method is one not at present favorably considered.

Cuspids, Bicuspid and Molars Combined.—Figs. 697 and 698 show bridge-work supported by a cuspid porcelain-faced crown and a molar gold cap-crown. If the cuspid is normal and contains a vital pulp, its vitality should be preserved and either an all-gold, an open-

face cap-crown, a three-pin plate or a Carmichael attachment, be applied in preference to the form illustrated. In the case of a pulpless

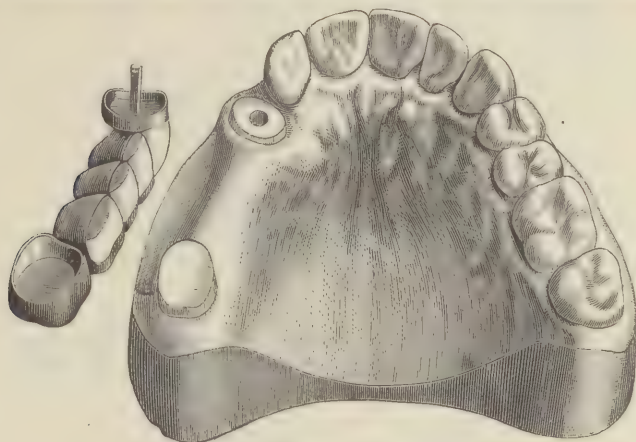


FIG. 697.

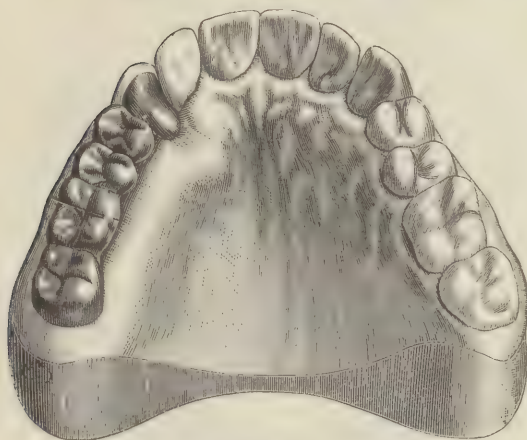


FIG. 698.

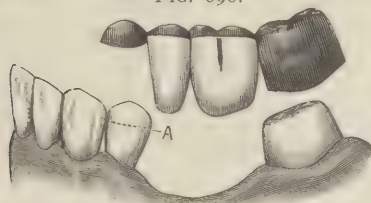


FIG. 699.

cuspid an inlay inserted on the lingual side with a post in the canal, is often preferable to applying an artificial crown as illustrated.

Bicuspids and Molars Combined. Use of Partial Cap.—Fig. 699 represents a bridge on the mandible from the first bicuspid to the second molar. The inclination of the teeth toward each other suggested the construction of the bridge in the form illustrated. The molar is entirely covered with a gold cap. The bicuspid is capped only on the occlusal third (A). A pin inserted in the cap fitting a hole drilled in the sulcus of the bicuspid secures the cap in position. A gold inlay extending across the sulcus with a short pin in the mesial end or a lug resting in an inlay might be used in preference. This latter method is very suitable in a case where the crown of the bicuspid is long and the root slightly exposed. Molars in a similar condition may be treated in like manner for bridge-work.



FIG. 700.



FIG. 701.

Figs. 700 and 701 illustrate a bridge supported by short gold caps on both bicuspid and molar. The caps in such cases may be swaged or cast. (See Figs. 514, 515, 600 and 601.)

Fig. 702 illustrates a case of bridge-work supported on an abraded bicuspid and molar by gold partial caps or tips with pins, the construction of which is described on page 231. It will be noticed that the molar tips forward considerably. The use of this method is preferable to using gold cap-crowns, which in this case would involve extensive trimming and probably pulp extirpation.

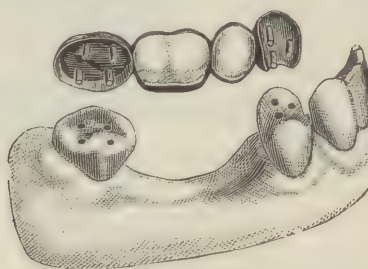


FIG. 702.

Fig. 703 represents a case in which the superior third molar and the first bicuspid are utilized for the attachment of a bridge to supply the loss of the intervening teeth. Fig. 704 represents the teeth prepared for the bridge. A, the lingual cusp of the bicuspid is cut down to allow the placing of a sufficiently thick cusp-cap; B, a hole between the cusps for a retaining pin; C, the third molar made uniform in size from neck

to occlusal surface, the latter having been sufficiently trimmed without removal of the pulp; D, a partial cap constructed so as to cover every portion of the bicuspid except its buccal surface, the edge of the cap

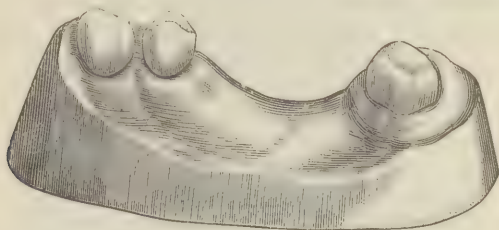


FIG. 703.

passing under the gum margin; E, a retaining pin adapted to the opening B; F, the gold cap for the molar.

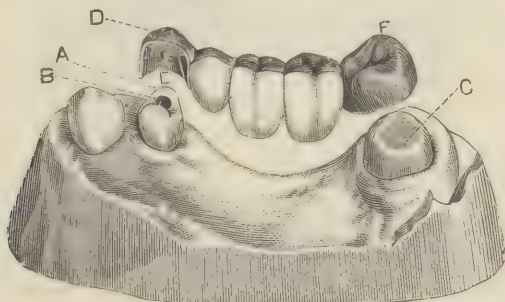


FIG. 704.

Fig. 705 represents the bridge anchored in position with cement. As the gold attachments and backings are out of sight, the appearance presented is natural. There is this fact to be considered in regard to



FIG. 705.

the use of the partial caps; many patients can be induced to consent to their employment who would refuse to submit to more radical measures, and thus, even when the latter would be advisable, the former may be employed as a compromise or even as a temporary expedient.

Having once tested the advantages of a well-fitting bridge, the wearer is more likely to consent at some future time when necessary to a more suitable form of construction.

Incisors, Cuspids, Bicuspid and Molars Combined.—Figs. 706 and 707 represent a piece of bridge-work extending from a central incisor to

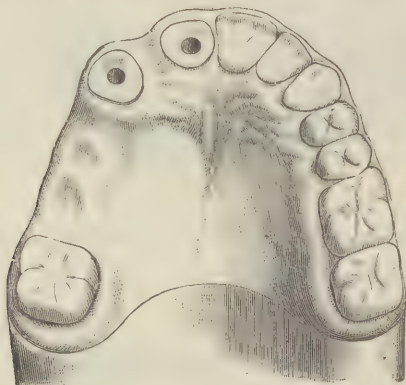


FIG. 706.

a molar. In such a case the best method, especially the one most likely to prevent misfit from warping, is to construct the front section, consisting of the central, lateral and cuspid first, next form the molar cap, fit it with the front section of the bridge in position in the mouth, remove in plaster impression and "bite," and then construct the bicuspid



FIG. 707.

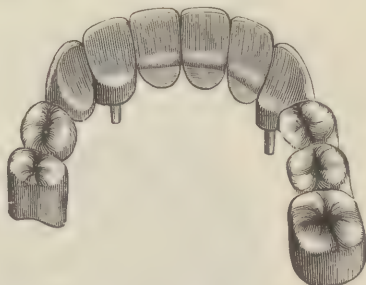


FIG. 708.

and molar pontics between the cuspid and the molar crown. First solder the bicuspid and molar pontics together to avoid warping and then unite them to the cuspid and molar crowns. In a bridge of this character, an open-face cap or other suitable form of attachment may be used for the cuspid, also a three-pin inlay attachment or lug on the central in cases where the natural crowns are intact.

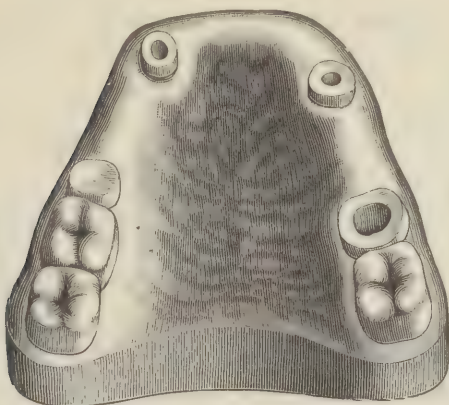


FIG. 709.

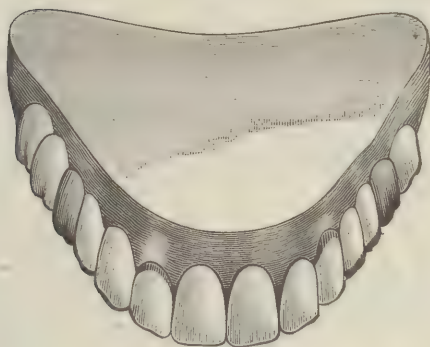


FIG. 710.

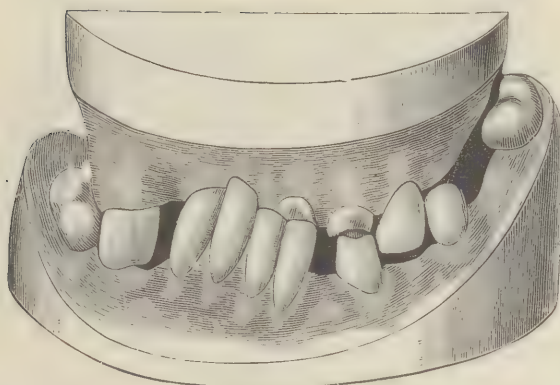


FIG. 711.

Extensive Application of Fixed Crown- and Bridge-work.—The following illustrations show cases of extremely large operations in fixed crown and bridge-work.

In the case illustrated in Figs. 708, 709 and 710, crowns on a second bicuspid, a pulpless molar and the roots of a cuspid and lateral constitute the abutments.

Figs. 711 and 712 illustrate an extensive case of artificial replacement by crowning and bridging operations. Fig. 711 represents the case as presented for treatment. The few remaining superior and inferior natural teeth had no corresponding antagonists, which caused the interlocking and abnormal occlusion shown. The superior right bicuspid, the left central and the left cuspid were crowned, the bicuspid being

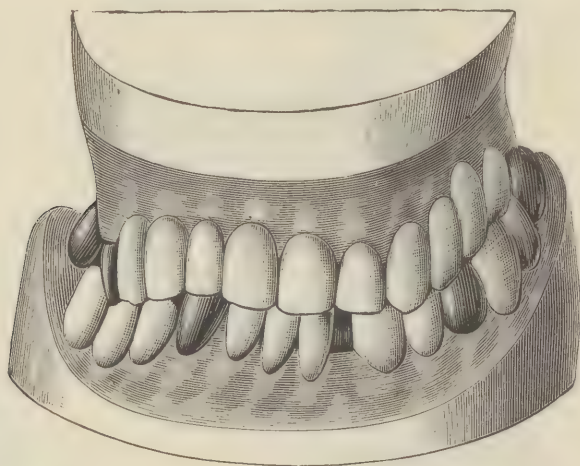


FIG. 712.

shortened and the cuspid lengthened in the operation. The intervening lateral root between the central and cuspid, having been treated and filled, was allowed to remain. With the three crowns to serve as abutments, the intervening spaces were bridged with artificial teeth, the extension on the left side being supported by a narrow saddle. The spaces between the inferior cuspids and molars on both sides were bridged, the bicuspid on the left supporting the bridge of the cuspid as on the right; the left cuspid was crowned and the incisal edges of the incisors trimmed even. Fig. 712 illustrates the finished case and shows the artificial restoration of the parts.¹

¹ Fifteen years after the performance of this work by Dr. H. A. Parr, the case was examined by the author. The membranes under the saddle on the left side had settled, leaving a space, but otherwise the work seemed to be in fair condition.

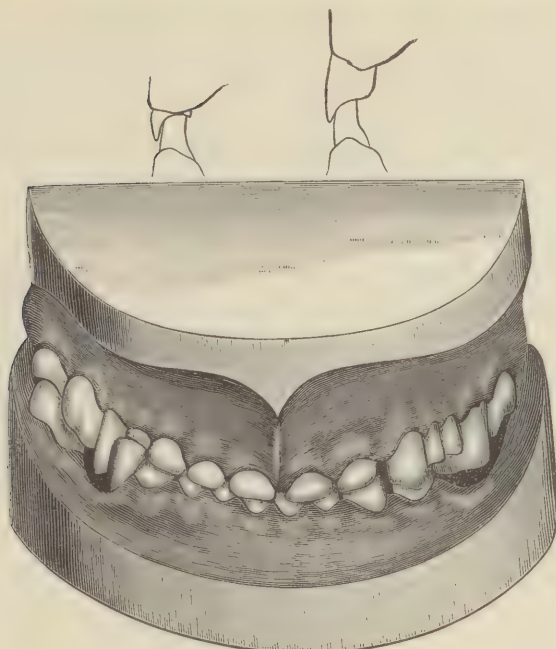


FIG. 713.

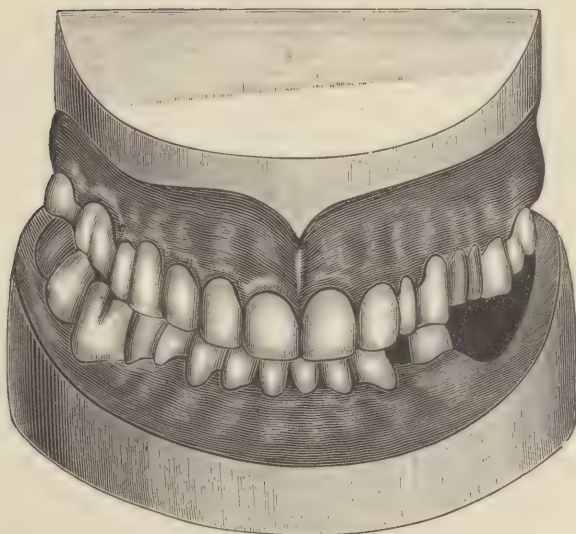


FIG. 714.

Figs. 713 and 714 represent an extensive case of crown- and bridge-work. The occlusal surfaces of the teeth were affected with abrasion. Gold crowns with porcelain facings which viewed laterally presented the form illustrated in outline in Fig. 713, were mounted on the incisors and cuspids, the pulps of which were preserved. The posterior teeth were crowned with all-gold crowns. The missing teeth, except those on the lower left side, were artificially restored with bridge-work.

Criticism.—Fixed bridge-work of the extensive character illustrated in some of the cases shown is seldom constructed now, for reasons which are discussed and explained in Chapter XII, pages 367 and 368. Removable forms with saddles affording alveolar support are adopted in preference. These cases are therefore presented to illustrate what has been done in the past history of the art, and *not as methods recommended for practice at the present time.*

CHAPTER XI

SECTIONAL AND DETACHABLE BRIDGE-WORK

Construction in Sections.—The construction of bridges, especially large cases, in detachable sections, is often desirable and advantageous. This is owing to the tilted position of some of the abutment teeth or roots which, in a case of bridge-work extended to both sides of the mouth, renders paralleling of their sides extremely difficult. Also, that plan is to be considered which will be the most suitable when the condition of some tooth or teeth present, included or not included in the bridge, as for instance when affected with pyorrhea, may suggest the probable necessity of removal of a cemented bridge in the future for alteration or addition. Removal of abutment crowns set with zinc



FIG. 715.

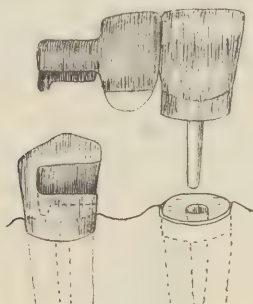


FIG. 716.

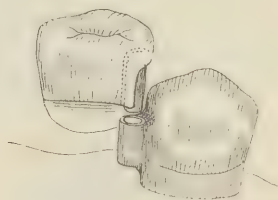


FIG. 717.

oxyphosphate is usually so difficult that they are mutilated or destroyed. In such cases, the most stable section or sections of the bridge—that is, the section or sections least liable to be removed should be made first and then the other section or sections formed to connect with them. This is accomplished by the use of a detachable connecting attachment or anchorage.

To explain such construction we will take the case shown in Fig. 706. The section from the molar to the cuspid can be made as the first section, and the central and lateral added, with a lug from the lateral as a supporting abutment anchored in the gold forming the lingual side of the cuspid, as shown in Fig. 715, and ready for insertion in Fig. 716.

Any required removal of the front section will leave the remainder of the work intact.

A pin that fits into a tube on the side of a crown such as is shown in Fig. 717 cemented with gutta-percha may be utilized as a retaining abutment.

Bar Attachment.—This form cemented to position with amalgam has the advantage over the use of an inlay in that removal of the amalgam will loosen the bar without injury to the anchorage cavity. It is a method now seldom used but it has advantages especially when applied to molars. (See page 318.)



FIG. 718.

Detachable Double-cap Bicuspid and Molar Crowns.—Such forms are at times desirable and preferable to the use of the previously described attachments, to permit the removal of a retaining cap or caps.

In the case illustrated in Fig. 718 the lines of the sides of the bicuspid and molar were trimmed parallel or only slightly tapering. The natural crowns having been considerably broken down by decay were shaped up with amalgam. Impressions of them were next taken in tubes with impression compound and amalgam dies made. On each of the dies a close-fitting cap of thin platinum about gage No. 38



FIG. 719.

was made in sections. The cap was first swaged on a fusible metal die made from the amalgam die, and transferred to the latter for the final shaping. The caps were fitted on the teeth and a plaster impression taken, removing the caps in position. The amalgam dies were then inserted in the caps and a model and articulation made, with the caps on their dies in the exact relationship they will hold in the mouth, as shown in Fig. 719.

Over each cap a second cap of gold was made which did not extend to the gingival margin by one-sixteenth of an inch (Fig. 720). The pontics were then constructed between the caps, as shown in Fig. 721.

The platinum caps were first cemented with oxyphosphate on the teeth. When it had set the gold crowns were cemented with gutta-percha cement over the platinum tooth-caps, from which they could



FIG. 720.

be detached at any time.¹ The thin platinum caps applied as described were quickly and easily constructed. Where erosion is active and

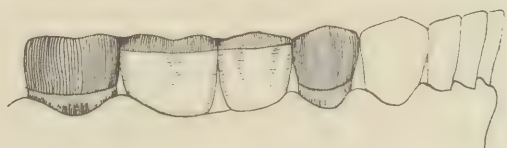


FIG. 721.

pyorrhea present, as in this case, they can be extended far under the gum margin to protect the dentin of the root without producing irri-

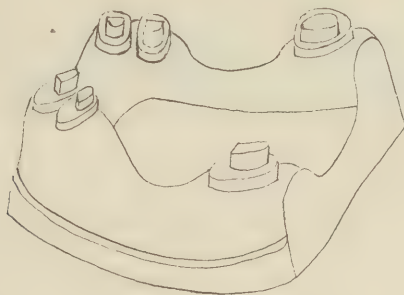


FIG. 722.

tation, if the platinum is tapered to a feather edge and closely fitted and burnished to the surface of the root.

¹ This case was constructed in this manner by the author, for the reason that the remainder of the teeth were being rapidly shortened by mechanical abrasion, and the intention is to open the "bite" later on and protect the other occluding surfaces. When this is done, the occluding surfaces of the bridge can be proportionately increased in thickness. A detachable form of construction was considered advisable for the reason also that the patient exercised such an unusual amount of force in occlusion, that repair or restoration of occluding surfaces was liable to become necessary at times.

Detachable Gold Semi-circular Post Crowns.—The use of detachable gold abutment crowns cemented with gutta-percha is a method that permits removal of the bridge very easily, and is especially applicable to cases of pyorrhea requiring periodical treatment that suggest the temporary removal of the bridge for the purpose.



FIG. 723.

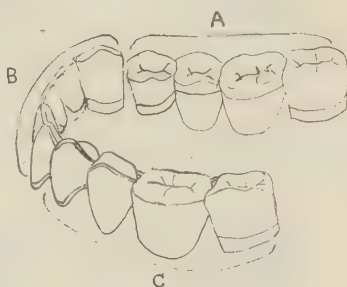


FIG. 724.

Fig. 722 shows a lower case with a sectional bridge. In this case the roots are trimmed to within about one-eighth of an inch of the gingival margins and gold collar caps with posts are fitted to each. Solid all-gold crowns are made for the molars and crowns with porcelain facings for the cuspids and first bicuspid. To each crown is fitted a large half-round or oval-shaped post attached to the cap, A, B and C, Fig. 723, show their construction in section. The teeth were reproduced in three separate bridges, as shown at A, B and C, Fig. 724.

CHAPTER XII

THE HYGIENIC CONDITION OF THE MOUTH AS AFFECTED BY FIXED BRIDGE-WORK

Consideration of the Subject.—The probable future condition of the mouth in which a piece of bridge-work is permanently cemented is a matter of the deepest interest to both patient and operator. There is no valid reason why an artificial structure in the mouth should be more hurtful than the natural teeth, provided that correct conditions are observed in its construction, and proper measures are taken for their maintenance. Collars imperfectly fitted at the cervix cause inflammation of the gingival margin and permit infection of the cement under them, which contributes additionally to the inflammation. In pulpless teeth this infection in the cement penetrates the dentin, in time reaches the pulp-canal and finally the apex of the root. This is one of the reasons why the apices of roots the canals of which have been properly treated and filled show areas of focal infection. The natural teeth demand care on the part of their owners, and equally or more so do all forms of artificial dentures require attention to secure their cleanliness and thus preserve the health of the adjacent tissues. The result of wearing a piece of fixed bridge-work is entirely dependent, in the first place, on the proper application of principles and skill in every detail of construction of both crowns and bridge; and in the second place, upon the maintenance of cleanliness. Neglect of a single requirement will so far detract from the usefulness of the work, that it may influence the final result disastrously.

Requirements.—Firm, properly selected abutments will not redeem incorrect conception or faulty construction; neither will the best workmanship remedy that which is wrong in principle or application. Self-cleansing spaces, if improperly formed, have exactly the contrary effect from what is intended, by becoming receptacles for particles of food debris, instead of preventing their accumulation.

Inaccessible spaces or interstices, which are apt to cause uncleanness, should be avoided. Continuity of structure of the several parts of crowns and bridges is essential to fully insure a perfect hygienic condition.

Methods of Cleanliness and Health.—The health of a mouth containing a piece of bridge-work constructed under these precautions can

be readily maintained. For this purpose a suitably formed tooth-brush and properly shaped bristle points in a porte carrier, which will reach places not cleaned by the tooth-brush, and a dentifrice, are necessary. Floss silk charged with tooth-powder or paste can be passed through interstices between the necks of the crowns by the aid of a slightly curved blunt-pointed needle and drawn along the gum under the bridge to remove accumulation of debris otherwise inaccessible. A solution of detergent mouth-lotion or disinfectant in water, or at times even plain warm water, injected with a dental syringe, or a fountain syringe to the end of the tube of which the small point of a dental syringe has been attached, can be used advantageously to wash out such places and maintain a healthy condition of the gums. The prophylactic measures, as outlined, should be practiced at least once or twice daily; if only once, preferably before retiring. In addition to the above, bridge-work should be thoroughly cleansed by the dentist at regular intervals.

So cared for, a fixed bridge will not militate against the absolute wholesomeness of the mouth; but it can hardly be expected that the insertion of bridge-work will insure a state of the mouth which for cleanliness will be superior to the presence of the natural teeth. Neglect on the part of the patient to perform such duties as are necessary to preserve the natural teeth in a healthy state will have about the same or worse effect on an artificial denture. The attention required to be given to bridge-work is not greater than is commensurate with the advantages which it confers on the wearer.

To offset the objections used against fixed bridge-work regarding hygiene in this era of oral prophylaxis, many practitioners favor the removable form. So constructed, the patient is able to remove, cleanse and replace the denture. This certainly is advantageous in an extensive piece of bridge-work. In the use of small cemented bridges of the anterior teeth, involving the use of not more than two abutments, if the work is properly constructed, especially respecting interproximal spaces and continuity of structure, the comparison is modified, as no appreciable advantage is gained by making it removable. The two crowns that constitute the abutments, if they stood alone, would not be classed as insanitary, if properly constructed and united to the roots or teeth with an antiseptic cement; why then, should the cemented abutments of an unremovable bridge be so considered? The pontic teeth that intervene between the abutments and lock in particles of food with the secretions constitute the objectionable factor. Cleaning the surfaces and interstices of such a bridge in the front of the mouth can be effectively performed by proper means, but not so easily as when removable.

An unclean condition of properly constructed fixed bridge-work is frequently attributable more to the fact that patients were not informed as to just how to take care of it, or did not possess the necessary means to carry out that care than to neglect on their part. In the former event the practitioner is at fault in having failed to properly instruct the patient and prescribe the needed care.

PART V

REMOVABLE BRIDGE-WORK

CHAPTER I

REMOVABLE BRIDGE-WORK

The evident advantages of bridge-work early stimulated the inventive genius of dental mechanists to improve the methods and forms of its construction and extend its application. With these objects in view, methods have been introduced by which bridges are so constructed as to be removable and replaceable by the patient. The importance of oral hygiene is now generally recognized, and the use of fixed bridge-work, as it cannot be removed for the purpose of cleansing, is criticised and by some entirely condemned. The removable form overcomes these objections. As a result removable bridge-work is being more adopted in practice. The merits of the various methods of its construction, especially respecting forms of attachments that most favorably permit pulp conservation are being studied and more actively discussed than formerly.

Limitations.—Large bridges are usually more easily made in a removable form than small pieces, which in contradistinction present some of the best features of the permanently attached methods. Many of the smaller bridges cannot be made removable as practically as the larger ones. In a large proportion of cases where properly constructed fixed bridge-work is applied, the removable feature would be of no material benefit as far as regards the health of the abutments or of the adjoining teeth; neither would it be of any great advantage regarding cleanliness. These reasons, together with the fact that removable bridge-work is most intricate and laborious in construction, largely combine to restrict its use to bridges requiring saddles, of the form termed removable plate bridge-work, using simpler styles of retaining attachments, which imperatively demands removal for cleanliness and health of the membrane on which it rests.

Requirements.—For removable bridge-work those methods should be selected and practiced that require the least mutilation of the crowns of normal-teeth and that do not demand pulp extirpation. In the construction the prime requisite is that the posts and collars, or other form of attachments used, shall be so constructed that the denture will move evenly on and off in adjustment and removal. To secure this, removable attachments and the section of the abutments

into which they fit must be so formed that the lines of the different parts are parallel to one another. This is absolutely necessary, if the denture extends to both sides of the arch, as otherwise the stability of abutment roots and crowns would be impaired, and in time irreparably destroyed by daily removal and insertion of the denture.

Examination Models.—Two wax or compound impressions and “bites” should be first taken, that will include all the teeth in each jaw, then plaster models made and mounted on articulators. One of these models is for the purpose of studying the case outside of the mouth and the preparation of the abutments, the other is to refer to later on. The most advisable method may be determined more easily by the aid of a model than in the mouth.

Forms of Crowns, Attachments and Supports

In removable bridge-work two classes of abutments are used: Retaining and Supporting.

Removable Retaining Abutments.—These forms hold the bridge firmly in position in the mouth, preventing its dropping or shifting. Tube and split-post collar crowns, telescope crowns, inlay and split-post abutments, or any devised abutments that firmly retain a bridge are Retaining Abutments.

Removable Supporting Abutments.—These are such forms as support an end or any part of a bridge, but do not retain it in position. A countersunk inlay or gold filling in which a lug rests or anchors, or any contrivance designed to support, but not retain a bridge, is a Supporting Abutment.

A knowledge of and practical experience in the formation of removable bridge abutments for pulpless teeth and those with vital pulps should first be acquired before commencing the construction of practical work. Accordingly, the constructive details of Retaining and Supporting Abutments, such as are used in the Peeso¹ and similar styles of bridges, will be given first so that they can be preliminarily practiced by the construction of one or more specimens.

The Tube and Split-post Attachment.²—This is much used as a retaining abutment.

The tube is made on a small steel mandrel. These mandrels are termed “Tube Mandrels” and are of six sizes, Nos. 1, 2, 3, 4, 5, and 6 (Peeso), closely corresponding to Nos. 48, 49, 50, 51, 52, and 53, twist

¹ So termed, as Dr. F. A. Peeso's systematic constructive details have contributed so much to improving the art.

² Iridio-platinum hollow wire is largely used for tubes of late in preference to making them. Ready-made tubes with split posts are also manufactured.

drill and steel wire gage (B. & S.), as shown in Fig. 725. The tube is made of ten per cent. iridio-platinum plate gage No. 32.

As the tube when finished will be one or two sizes larger than the mandrel on which its shaping is started, calculation should be made accordingly in selecting the size of the mandrel. A canal, for instance, that will receive a tube on a No. 4 mandrel requires mandrels Nos. 2 and 3 for shaping and No. 4 for finishing.

To systematize the subject of the size of tubes in their application to canals, the tube is given the number of the size of the last mandrel it was swaged on or the one over which it fits tightly. So regulated in size, Nos. 1 and 2 tubes are used in small roots, such as the superior laterals and bicuspid, Nos. 2 and 3 in superior



FIG. 725.



FIG. 726.



FIG. 727.

central incisors, Nos. 3 and 4 in large superior centrals and in both superior and inferior bicuspid and Nos. 5 and 6 in superior and inferior molars.

A piece of plate seven-sixteenths of an inch wide is cut in the direction the metal has been rolled, perfectly square on the end and beveled to a knife edge (Fig. 726). Anneal the plate, dip it in acid and wash and dry perfectly. Turn the edge of the iridio-platinum evenly at an angle, as shown in Fig. 727. This is best done by seizing the edge in a hammer-headed hand-vise with seven-eighths-inch jaws, the serrations of the jaws having been removed and the edge of one of them rounded (A, Fig. 728), and bending the platinum over the rounded edge (B). The platinum is laid on the surface of a flat anvil, the mandrel selected for starting is placed in the fold of the platinum, the shank of the mandrel being held by a pin vise, and the edge of the platinum gradually turned over with a fine flat file to meet the surface of the platinum strip, as shown in Fig. 729. The mandrel can be slightly rolled in the operation to bring the edge against the surface of the plate (Fig. 730), but it must not be rolled beyond that point, as that would double the plate, as shown in Fig. 731. The mandrel is removed, a very small piece of pure gold is placed in the seam and the tube is held in a Bunsen flame

(Fig. 732). When a sufficient degree of heat is reached, the gold will flow along the seam and form a joint without obstructing the passage of the mandrel inside. If it does obstruct, too much gold has been used. Heating the tube to a high heat may correct this by diffusing the gold through the platinum. If not, a new tube must be formed.

The next size larger mandrel is then forced through the tube to stretch the metal and smooth the inside. This is best accomplished by placing the end of the tube against the surface of an anvil, and tapping the mandrel through, as shown in Fig. 733. The tube is then annealed and enlarged to the size of the next larger mandrel. The

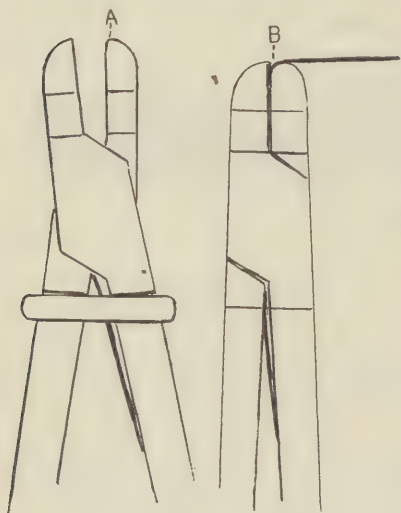


FIG. 728.

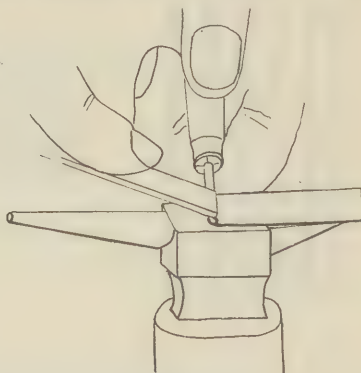


FIG. 729.



FIG. 730.

surplus metal is removed with shears, resting the flat side of one of the blades against the surface of the metal. The joint is trimmed even with the rest of the tube with a fine flat file. Should the tube fit the mandrel so tightly as to be difficult to remove, roll the tube and mandrel under a dull, smooth flat file, to slightly stretch the tube. To close the end of the tube trim the metal even, slightly burnish in the edge (Fig. 734), and over the opening solder a piece of metal of the same gage as the tube. This is most easily done by placing a small piece of the platinum on a charcoal block, melting a particle of pure gold on its surface, and then placing the end of the tube against it and again fusing the gold, as shown in Fig. 735. The surplus plate is then removed and the part finished with a fine file.

The point of the mandrel selected as the size for the tube is inserted

in the orifice of the tube, its closed end placed on a block of lead, and the mandrel driven into the tube, giving it the exact dimensions and the end a slightly coned form.

Seamless Tubes.—Seamless drawn tubing is being preferably used for tubes instead of forming them. The seamless drawn tubing is made of 15 per cent. iridio-platinum. The walls are .0045 inch, which is about 37 gage. The additional percentage of iridium in the alloy imparts great rigidity and strength to the tube. This accordingly permits the use of a thinner gage of metal for the walls, thereby proportionately lessening the space necessary for the tube in the root canal.



FIG. 731.



FIG. 732.

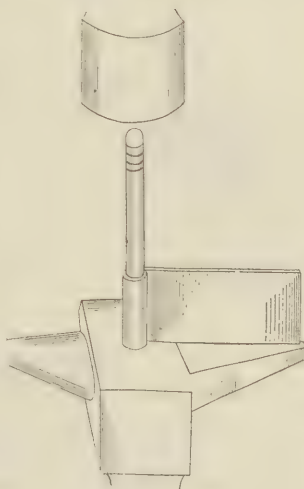


FIG. 733.



FIG. 734.

A piece of the seamless drawn tubing $\frac{1}{16}$ inch in length and slightly smaller in diameter than the selected mandrel, is cut off and the tube stretched to fit by tapping the mandrel into it, in the same manner as in the use of a soldered tube, and thereafter the construction of the two forms is identical.

Construction of the Split Post.—The post is made of half-round platinized gold wire (gold clasp metal), gage No. 12 to 15, and when doubled about one-fourth inch longer than the tube. The most convenient way is to use a long piece of wire and double one end of it for a post as required. The gage of the wire when doubled should be slightly greater than the diameter of the hole in the tube. The average is gage Nos. 14 for No. 1 and 2 tubes; gage No. 13 for Nos. 3 and 4, and gage No. 12 for No. 5 and 6. The sharp edge of the wire should

be rounded so that the finished post will have a very small seam on each side that will indicate and easily permit the introduction of a thin knife blade to effect expansion, as shown at A and B, Fig. 736. The required length of wire is bent about one-eighth of an inch from the center and the flat side of the shorter end brought against the side of the other so that the longer end extends as shown in Fig. 737. The wire should be well annealed before being bent, and each time between the bendings.

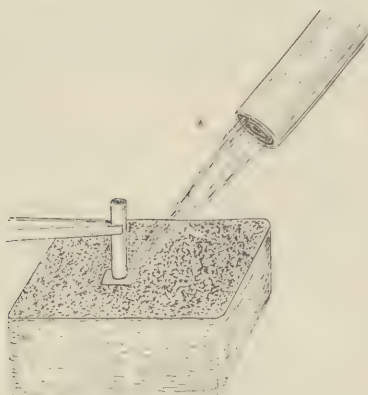


FIG. 735.

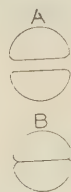


FIG. 736.



FIG. 737.



FIG. 738.



FIG. 739.

When the shorter end of the wire meets the longer one, the flat sides are brought together, as shown in Fig. 738, and so held by a soldering clamp and heated to a red heat, then plunged into water. This sets the portions of the metal brought together in close contact, in which position they remain while being soldered. The loop portion is next held by a clamp and the ends united by the least possible quantity of coin gold, using the long end of the wire as a shelf to hold the solder, as seen at A, Fig. 739. The ends connected in this way leave the loop section to form the split-pin post. The extending end of the wire is grasped in a pin vise and the loop portion hammered together first on the face, and then in the groove of an anvil. Between the blows of the hammer the post must be rotated so that the two sides will be forged round as they come in contact (Fig. 740). As a safeguard against invasion of the solder in the seam of a split post in any of the subsequent soldering operations, rouge or a very thin film of mica may be placed to remain in the seam between the two halves of the wire before they are brought together.

Another Method.—Cut off a piece of the half-round wire that closely fits the tube and about $\frac{1}{4}$ inch longer. Cut off another piece

of the wire $\frac{1}{16}$ inch longer than the first one. Paint the flat sides of the wire with rouge as far as it enters the tube. Insert the two pieces of wire in a short piece of stock seamless drawn tubing or of soldered tubing that it will fit tightly, as shown in Fig. 741. Flux the extended ends (A), and unite them with a particle of coin gold. Remove from the tube and place the tube end of the united wire in a pin-vise, trim the soldered end so it will be slightly less in gage than the tube end.

The soldered end of the post is grasped in a pin vise, leaving the portion that fits in the tube exposed, which is to be trimmed uniformly round with a flat file. The fit of the wire to the tube should be tested frequently by placing the orifice of the tube over the point. When the

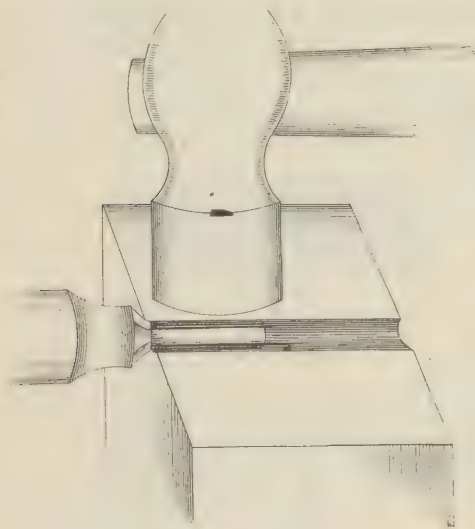


FIG. 740.

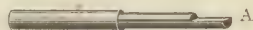


FIG. 741.

post begins to approach the required size, it is mounted in a true-running chuck on a lathe, and further uniformly reduced with a very fine flat file, the serrations of which are worn smooth, applied lightly against its surface with the smooth surface of a burnishing file against the other. When the post nearly enters the tube, it may be further sufficiently reduced with fine emery cloth applied on a flat stick. The post, having been reduced to very tightly fit the tube, is then burnished by passing a burnisher lengthwise over its surface to remove the fine scratches of the emery cloth, and give it a uniformly smooth polished surface. This generally permits the post to freely enter; if not, it must be further reduced and again burnished. The post should enter and move in the

tube uniformly the entire length, and require but a moderate amount of force to insert or remove it.

The use of a split post with a closed point, is confined to a case requiring a very long tube and where the posts when removed from the tube will be so exposed that the slit can be easily reached on the sides and expanded. The open end split post is the best form to apply in short tubes and in all-gold bicuspid and molar telescope crowns, as in the latter the slit at the end of the post is more easily reached than on the side.



FIG. 742.

When the end of a split post is being removed sufficiently to slightly expose the slit (Fig. 742), the movement of the file or stone should be directed in the line of the slit, to avoid springing the sides of the post apart as the slit is reached.

Split-post Burnisher.—Fig. 743 illustrates the Weinstein burnisher. The post is placed in a revolving chuck of a lathe, the burnishing tool is opened, the post placed in the grooved side and the smooth side closed gently on the post. The chuck is then revolved and the post

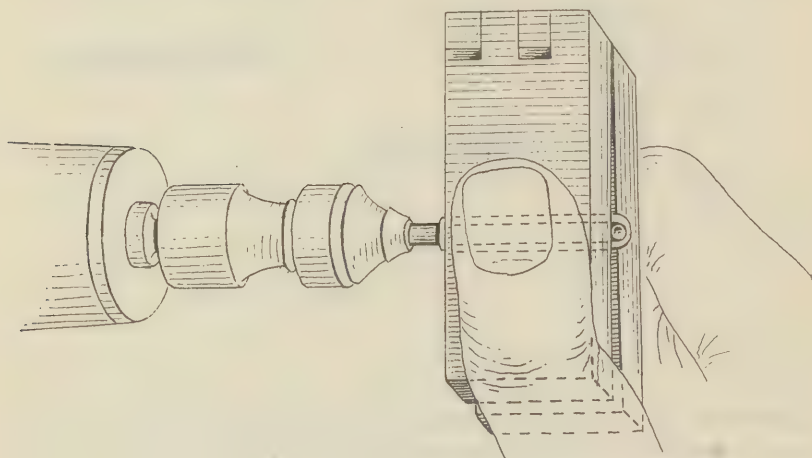


FIG. 743.

burnished by its revolutions against the burnished steel. The tool is gradually clamped together tighter on the post as the burnishing progresses.

The use of tubes and split posts is much facilitated by having on hand a number of different sizes ready-made. The most suitable size can then be immediately selected. These posts may be formed at a convenient time, or by an assistant.

Telescope Crowns

This form is used on pulpless bicusps and molars in removable bridge-work. When used as a supporting abutment the crown is made without a post; as a retaining abutment, with a post.

The sides of the natural crown are trimmed as for an ordinary gold crown, but given a slightly more conical form. The occlusal section requires to be removed enough to allow for the thickness of not only the inner, but also the outer cap (Fig. 744). Gold coin or a correspondingly hard gold plate, which will not stretch in wear, is absolutely necessary, especially for the outer telescope crown.

The collar is made of gold, gage No. 30, cut with a very slight flare toward the cervical edge, as indicated in Fig. 745. The joint is sweated, or united with hard solder. The collar is fitted closely to the cervix of

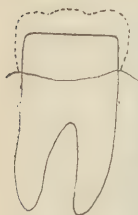


FIG. 744.

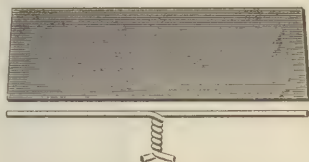


FIG. 745.



FIG. 746.



FIG. 747.

the tooth and uniformly extended well under the gingival margin. The sides and occlusal end of the collar should be given a curve corresponding to the cervical section, so that the outer collar shall fit and move uniformly over it (Fig. 746).

The edge of the occlusal end of the collar is trimmed off enough to leave room for the floor and a thick cusp-cap. The extreme occlusal edge of the collar is turned inward with small pointed pliers so as to give it a rounded form, as shown in Fig. 747. This is for the purpose of permitting a slightly rounded edge to be given to the occlusal end of the inner crown. This rounded edge is to facilitate the adjustment of the collar of the finished outer crown by allowing it to more easily slip to place, especially should it be inserted a trifle out of line.

The rounded edge of the collar is filed level so that all parts are in the same plane. The floor is made of the same gold as the collar, gage No. 28, cut to the required size. The plate is made perfectly flat by swaging in the Peeso swaging device, Fig. 748. The plate is annealed, dipped in acid, washed and sweated or soldered to the collar. The edge

of the surplus gold is cut and ground level with the sides of the collar and polished (Fig. 749).

The Outer or Telescoping Cap.—The inside of the inner cap is varnished, a strip of paper is wound closely around it and secured with a wire or rubber band (Fig. 750). Fusible metal that melts below 212° F. is then poured into the paper tube (see "Casting the Die," page 28). This practically makes the gold cap a die on which to form the outer cap. The fusible metal is later removed by immersion in boiling water.

The measure of the circumference of the outer collar is taken at about the middle line of the inner cap, a little towards the occlusal end,

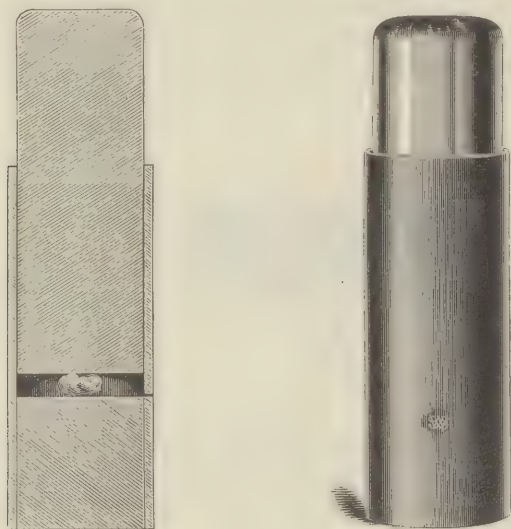


FIG. 748.

as indicated at A, Fig. 751. The gold is cut with a slight flare as for the inner cap. The joint of the collar is made with a slight overlap. The collar is slipped over the horn of the anvil, the joint hammered and then filed level. The collar is annealed and placed on the inner cap-die and pressed down with the finger as far as it will go. The occlusal edge of the collar, which must be level, is placed on the flat surface of the anvil and the die is hammered into it to position (Fig. 752). If difficulty is experienced in the removal of the collar from the inner cap, burnish with a plate burnisher on the sides in a circular direction around the collar, especially toward the cervical section; wind a piece of cloth around the collar, then seize and remove with the fingers. The collar is replaced on the inner cap, the cervical edge is marked and trimmed off

to about one-sixteenth of an inch short of the line of the gum margin of the inner collar, as shown in Fig. 753. The occlusal edge of the outer collar is trimmed a trifle flush with the surface of the floor of the inner cap, the edge is pressed inward with a flat file and then filed perfectly level with the surface of the floor. The collar is removed and a floor of gold, gage No. 30, sweated or soldered to it. The floor is either trimmed flush at the mesial and distal sides and allowed to only slightly extend at the lingual and buccal, or it is trimmed even with the sides of



FIG. 749.

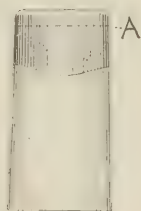


FIG. 751.



FIG. 750.

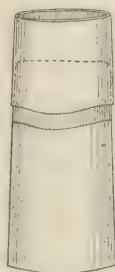


FIG. 753.

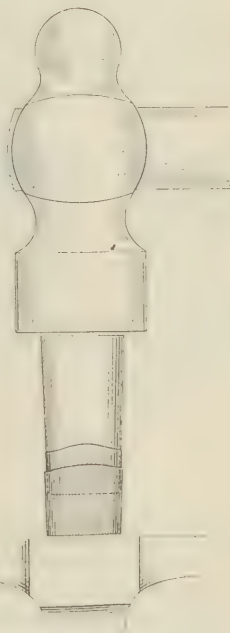


FIG. 752.

the collar, as required by the method of construction of the cusp-cap. Remove the inner cap from the die, place it in the mouth, adjust the outer cap, take a "bite" and make models.

Contour.—As the outer cap sits on the inner one, it presents no contour. Contour is usually formed by two different methods in accordance with conditions presented. (a) Trim the floor of the outer cap even with the collar. Form on the cap a wax model of the required cusp-cap, that will also include the required contour on the sides, as outlined by the dotted line in Fig. 754; remove wax model and cast it in gold. When cast, fit it on the outer cap, making any necessary alterations for contraction of the metal in casting, and wax it fast around the

edge to the collar of the outer cap. Remove the outer cap from the inner with the cusp-cap in position, paint the cavo-surface of the outer cap with rouge and fill it with investment material. The cap will then appear as shown in Fig. 755. Solder the cusp-cap to the outer cap by fusing the solder in small pieces around the edge and drawing it under the cusp-cap, see Fig. 383. This method of contouring is best suited to short crowns, crowns requiring only a small amount of contour, or crowns on lower teeth where weight is not a factor.

(b) Trim the floor of the outer cap on all sides to the full and exact line of the size and shape of the required contour, as illustrated at A and B, Fig. 756. Form a cusp-cap by casting a wax model of the required form or by the cusp-button method (see page 166), and solder



FIG. 754.

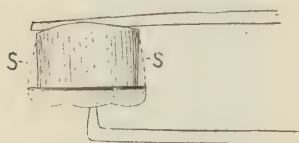
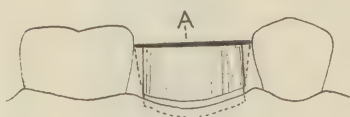
FIG. 755.—IM,
Investing material.

FIG. 757.

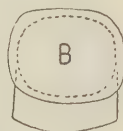


FIG. 756.

it in position on the floor. When the cusp-cap is soldered, fill the inside of the crown with investment material, heat the crown slowly to dry out the investment, and contour the collar to the dotted line SS, Fig. 757, with as hard-flowing solder as the collar will bear, using the extension of the floor as a shelf on which to place the solder. This method is for short crowns, or long ones requiring but very little formation of contour.

Telescope Crown with Tube and Split Post.—When a telescope crown is to be used as a retaining abutment, the addition of a tube and split post is required. When two telescope crowns alone are used on the same bridge, one of them should contain a tube and split post. The use of telescope crowns with tube and split post is principally confined to molars.

The inner collar having been formed, the tube selected is mounted on a mandrel and placed in the collar with the point resting on the floor of the pulp-chamber. A wire representing the tube in gage may be used instead of a mandrel. When necessary for a more secure attach-

ment, as in the case of an upper molar, the tube or wire is inserted a short distance in the palatal root, and in a lower molar in the mesial root. The tube is to be paralleled to any other tube or tubes and abutments present, as described in the construction of a removable bridge. The tube also must be parallel to the median line of the sides of the inner collar to permit the post to move in and out freely in the tube of the inner cap when the crown is finished. The tube and collar, having been waxed together, are removed in the impression taken for the bridge and a model made.

When a post in an outer-cap that has been paralleled to the other tubes and posts does not properly adjust itself to the orifice of the tube in the inner cap, the defect is attributable to the fact that the sides of the inner cap are not shaped in conformity with the line of the other abutment, or the inner collar had not been suitably shaped when constructed.

The sides of the inner collar should slightly taper towards the lines of the post. This is tested by placing a narrow separating file against the side, as shown in Fig. 758.

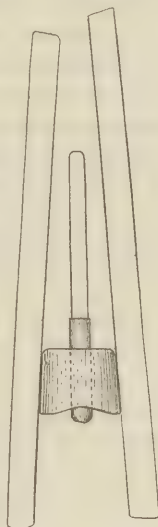


FIG. 758.



FIG. 759.

Fig. 759 shows a cap in which the collar on one side leans toward the post and on the opposite side from it. In the latter case, although the sides of the tooth and cap are slightly cone-shaped and the edge of the floor rounded, the edge of the outer collar will meet the inner cap at the point A, and prevent adjustment of the post in the tube. This can only be corrected by properly shaping the side of the tooth at that point and fitting suitably shaped new inner and outer caps.



FIG. 760.

The tube having been properly paralleled it is removed and a floor of gold, gage No. 28, is sweated or soldered to the outer collar and the excess removed. A hole is made through the floor over the hole in the impression formed by the tube or wire about one and one-half times the diameter of the tube. This extra space is later on to allow for the formation of a countersunk approach to the tube for the post, as shown in section in Fig. 760. The tube is placed in the hole in the floor and paralleled with the other abutments and also adjusted to conform to the sides of

the inner cap. The tube is then waxed to the floor. The wax should be melted into the space around the tube and under the edge of the floor, as seen at B. The wax is chilled, the mandrel removed from the tube, the cap and tube invested, dry asbestos fiber being packed in the tube. The tube is then soldered to the floor. In soldering, the flame should be directed around the tube and then under the investment to draw the solder down into the space around the tube. The cap having been boiled in acid, the tube is cut off and filed even with the floor and the cap polished.

The inside of the cap is next varnished. When the varnish is dry the crown is filled with fusible metal. The outer collar and floor having been made and contoured, the location of the orifice of the tube is marked on the inner surface of the floor, by holding the cap firmly on the die, tapping the end of a piece of wood



over the spot, or by passing a revolving burnisher over it. A hole is then made large enough only to admit the split post.

FIG. 761.

For a telescoping gold crown the point of the post should be removed sufficiently to expose the slit, so as to permit the post to be expanded at the point instead of the side, or so little of the gold should be left at the point of the post that it can be easily removed and the post expanded. The orifice to the tube is next countersunk with a cone-shape fine bur, the debris washed out with a fine-pointed syringe and the split post fitted. Countersinking the neck of the tube removes the contraction caused by the solder and enables the point of the split post to more readily find the opening when the crown is finished; it also allows the post to adjust itself better to the deeper portion of the tube (Fig. 761 in section).

The cusp-cap is next made and fitted. The orifice of the tube on the inner side of the cusp-cap is indicated by placing on its surface a thin layer of wax and pressing to position. A hole is drilled through the cusp-cap large enough to freely admit the split post. When a cast cusp-cap is used, if a carbon the size of the post is placed in position in the wax model before casting, it will facilitate the forming of the hole. The cusp-cap when constructed is temporarily laid aside.

The outer cap is adjusted on the inner cap, the split post is placed in position in the tube with the slit in the post set in a bucco-lingual direction, the post cemented with wax to the floor of the outer cap, removed, invested and soldered with 20-carat solder. The hole in the cusp-cap is next trimmed and enlarged so as to leave a slight space on all sides around the split post when it is adjusted to position.

The end of the split post is cut off a little below the surface of the

cuspcap to permit the end to be covered with solder. The floor of the outer cap and the base of the cuspcap are cleaned and coated with liquid flux, and the cuspcap placed in position on the floor and waxed around the edge, and the outer cap removed. A strand of wire may be used to secure the cuspcap immovably to the floor. The inside of the outer cap is painted with rouge and invested nearly up to the edge of the cuspcap, as shown in section in Fig. 762. The wax is removed and the investment slowly heated. The cuspcap is then united with solder fused in the hole

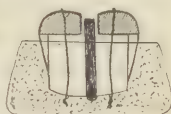


FIG. 762.

around the end of the post. The solder is applied a little at a time in small pieces or globules, or in strip form. A small flame should be directed on the solder and then around the sides to draw the solder between cap and floor until it shows in the seam, which indicates complete union. The crown is finished in the usual manner. Fig. 763 outlines in section the finished crown.



FIG. 763.

Removal of the Cap from the Die.—Any time during the construction that removal of the fusible metal from the cap is required, the die and crown are placed in boiling water and the metal melted out. The crown on removal from the water is placed for a time or boiled in nitric acid, to insure the entire removal of the fusible metal, as a minute particle left adhering would cause a perforation when the crown is heated.

Tube and Split-post Anterior Crowns

Incisors, Cuspids and Bicuspid with Porcelain Facings.—For these crowns the end of the root is given a form similar to that required for a collar crown (Richmond). The sides of the root must be shaped and the canal reamed for the tube so that it shall be parallel with the other abutments. The end of the root is trimmed in a slanting plane from the lingual to the cervico-labial side. At the cervico-labial section the end of the root should be trimmed not more than one-thirty-second of an inch under the gum margin, or only enough to hide the edge of the collar. When more of that part is removed the gingival edge is liable to crowd over the edge of the floor of the cap and be pinched in the reinsertion of the crown (Fig. 764). The canal is enlarged lingually a little with a reamer, so as to permit as good an attachment as possible for the end of the split post, and later facilitate correct placing of the facing. The end of the root should be left extending slightly above the gingival margin until the collar has been fitted.

The collar is made of coin or 22-carat gold, gage No. 30. After

the collar is fitted the end of the root and collar are trimmed to the same level, as indicated in Fig. 765. The edge of the collar and the floor must meet at every point and are either sweated or soldered together. If soldered, the smallest possible quantity of hard solder should be used. The surplus metal of the floor is removed and a hole made through the floor for the tube.

The hole in the floor for the tube, as in the case of the telescope crown with tube and split post, should be made at least half again larger than the tube to allow the solder to flow around the tube and permit the orifice to be countersunk (Fig. 766). The cap is adjusted on the root, the tube mounted on a mandrel and placed in the reamed canal and paralleled to the other abutments. The tube is then waxed to the cap and removed.



FIG. 764.



FIG. 765.



FIG. 766.

The tube and cap should now be examined to see if the line of the tube with the collar is such as will permit the outer cap when finished to move on and off without interference. This is easily determined by the eye—with a mandrel in the tube—or more positively by placing a flat separating file against the sides, the same as in the case of a telescope crown. Fig. 767 shows a correct alignment of the tube, and Fig. 768 an incorrect alignment. If the alignment is incorrect, it must be changed by trimming the root and making a new collar. If correct, the mandrel is seized with pliers, a small chisel is placed against the edge of the tube, which is pushed off the mandrel, invested and soldered to the floor. The solder is flowed down and around the tube, as explained in the construction of a telescope crown with a tube and split post.

Having been boiled in acid, the tube is cut off and ground level with the floor. The neck of the tube is countersunk with a cone-shape finishing bur, and reamed enough to correct the contraction of the solder. The cap is then polished, the debris in the tube removed by a fine-pointed syringe with water, the tube dried and the split post fitted.

The Outer Cap.—This is a half-collar cap, retained by the split post fitted to the tube of the inner cap. It is to carry a porcelain-

faced gold crown or one of porcelain. The half-collar lessens the strain on the split post and aids in strengthening the crown. To avoid irritation, the edge of the half collar must be trimmed free of the gingival margin one-sixteenth inch.

To prevent any accidental disturbance of the form of the inner cap during the fitting of the outer one and to facilitate the work, the inside of the inner cap should be filled with fusible metal that melts below 212° F. This is best done by inserting the cap in moldine in a flask ring, as shown in Fig. 769.

The half collar is made of the same plate as the inner collar gage No. 30. It is most easily constructed by first forming the outer collar to entirely encircle the inner collar. The edge is trimmed even

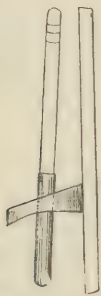


FIG. 767.

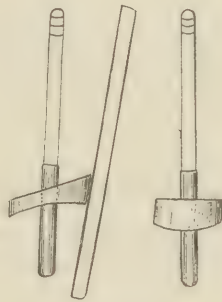


FIG. 768.



FIG. 769.

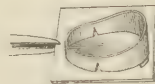


FIG. 770.

with the floor of the inner cap, a floor of gold plate, gage No. 28, adapted; collar and floor removed and united to it with 21-carat solder. In uniting the collar to the floor the attachment with the solder should be confined to the lingual section that is to remain. This is best accomplished by notching the collar on both sides, as shown in Fig. 770. The solder, if only a small quantity is used, will be confined to the lingual section by the vacancy caused by the notches in the collar, which will consequently leave the labial portion ununited and easy to remove.

The floor of the outer cap is next trimmed even with the sides of the collar. The outer cap is fitted on the inner, burnished or swaged to its surface, and the floor perforated. It is then held firmly on the inner cap, and the hole enlarged sufficiently to allow the post to pass through. The post is waxed to the floor, the cap and post removed, invested and soldered together.

The slit in the split post should be placed in a labio-lingual direction for strength, as shown in Fig. 771. The loose labial section of the

collar in front of the notches is next removed and the lingual section remaining trimmed and finished, as shown at A, Fig. 772, and at B, in position on the inner cap. The inner cap is released from the die with boiling water and nitric acid. If properly constructed in all its details

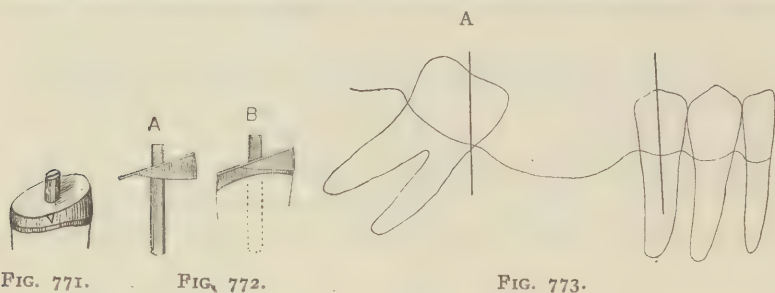


FIG. 771.

FIG. 772.

FIG. 773.

the result will be a crown base reliable as a retaining abutment and uniform in adjustment and removal. The porcelain facing is fitted to the outer cap, the outer cap removed, invested, and facing and cap united with solder the same as in the case of an ordinary crown.

Converging Teeth and Roots

When a molar converges as shown in Fig. 773, it can only be paralleled to the anterior abutment, for a telescope gold crown, by shaping as indicated by the line A. To so shape a normal crown would demand pulp extirpation. In a case such as this a removable attachment in an inlay should be used and pulp extirpation avoided. The same method of treatment should also be applied to bicuspid.

Retaining Inlay Abutments

Retaining Abutments.—Attachments of this form are for application to pulpless teeth when the natural crown is to be preserved in part. The attachment consists of a countersunk gold inlay with a tube into which fits a supplementary or male inlay, with a split post. It is used where a central incisor is utilized as an abutment and it is desirable to preserve the natural crown as nearly as possible intact. It is preferably used in a cuspid which is to act as an abutment to support a lateral with the assistance of a lug on the central. It also is applied in the mesial side of a molar abutment, and in cases where the shape or position of a tooth suggests its use as being preferable to a crowning operation.

Bicuspid and Molars.—A molar will be used to explain the method. The cavity for the inlay is made in the occlusal surface about one-half the length from mesial to distal side, as shown at A, Fig. 774, and in the mesial or approximal side, large enough to furnish room for the matrix

or female inlay that is to carry a supplementary or male inlay with a tube and split post, as shown at B.

Fig. 775 outlines in section the assembled portions of a removable inlay attachment with a split post. The orifice to the canals and the body of the pulp-chamber are first filled with cement, preferably oxychlorid of zinc. To prevent pressure on the inlay splitting the tooth, the side walls should be made nearly straight, slanting but very slightly outward—and the bottom of the cavity flat or nearly so. Provision for the tube should be made, which should extend to the floor of the pulp-chamber and, if necessary for security, be inserted a short distance into one of the roots.



FIG. 774.

The palatal root of an upper molar or the mesial root of a lower molar is usually selected. The tube should be the largest the tooth will properly allow, so as to carry a correspond-

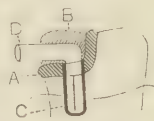


FIG. 775.—A, Matrix or female inlay; B, supplementary or male inlay; C, tube; D, bent split post.

ingly larger tube, if possible, in the case of a molar, No. 5 or 6.

The Matrix or Female Inlay.—This can be made by the direct method but not with the same facility or accuracy as by the indirect, consequently the latter will be described. The cavity having been shaped, as outlined in Fig. 774, an impression is taken with impression compound and an amalgam die made.

A cast matrix of gold alloyed with three to five per cent. of copper is made for the cavity. This is done by shaping a sheet of wax, about one-sixteenth inch in thickness, to the cavity and slightly over the margins (Fig. 776). The wax is perforated over the indentation in the die for the tube and a carbon inserted. A sprue wire is inserted in the edge of the wax, and the wax matrix is lifted from the cavity, invested and cast.

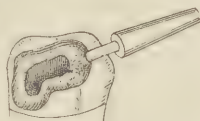


FIG. 776.



FIG. 777.



FIG. 779.



FIG. 778.

The cast matrix is first fitted to the die and next in the tooth. The edge of the casting is brought close to the margins of the cavity with a piece of orange wood, tapped on the end with a mallet and next a revolving burnisher passed over the part. The hole in the matrix

the tube is enlarged to fully the size of the diameter of the tube (Fig. 777). The tube mounted on a mandrel, is inserted in the hole

(Fig. 778 in section) surrounded with wax and paralleled to the other abutments. Matrix and tube are removed and then the mandrel from the tube, and matrix and tube are invested and united with solder.

The matrix and tube having been adjusted in the cavity to determine the accuracy of the position of the tube, they are removed and the extended end of the tube trimmed level with the floor of the matrix, and its orifice slightly countersunk, so that the split post may enter more freely (Fig. 779).

The gold of the side walls of the matrix cavity is to be trimmed so as to give them proper form in detail. The forward section of the cavity should be deep and narrow for strength in preference to being made broad and flat. The cavity having been properly shaped the surface of the gold is then smoothed and burnished with a revolving burnisher.



FIG. 780.

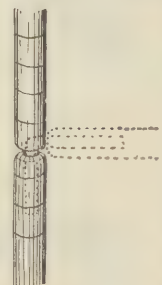


FIG. 781.

Split Post and Supplementary or Male Inlay.—

A post is fitted to the tube. The slit in the post should be placed in a labio-lingual direction. The slit at the point of the post should be left closed, so that it will not open when the post is bent. The point, though, should be filed flat, moving the file in the line of the slit, and the edges slightly rounded. Enough should be removed at the point to closely approach the slit so that at any time, if desired, the filing of a slight groove will reach the slit and permit the post to be expanded from the point.

The matrix to the supplementary or male inlay is made by shaping and burnishing a matrix of pure gold, gage No. 36, or $\frac{1}{1000}$ platinum, into the female cavity and well over the edges, frequently removing

the matrix and annealing. A hole is made in the matrix over the tube, the split post inserted, the line of the floor of the matrix marked on the side of the post, the post withdrawn and bent level with the floor of the matrix, preferably using a pin bender instead of a pin vise or pliers.

A Pin Bender.—A post can be bent with a pin vise, but the bending is best done by the use of a pin bender, which is really a tube into which the post fits accurately. The set consists of three tubes. The holes in the ends of each are proportionately increased in size, so as to accom-

moderate six sizes of posts, as shown in Fig. 780. Select a size corresponding to the post, anneal and insert the post—closed end first—as shown in Fig. 781, and with the extending portion inserted into another pin-bender or pliers, bend it to the required angle, annealing several times.

The orifice of the tube is slightly oiled. The male matrix is annealed, adjusted in the cavity and the post inserted. Adhesive wax is then melted into the matrix and around the post, and pressure exerted on the wax to bring all parts to position. The wax is chilled, the matrix and post removed, invested and the matrix filled with coin gold. It is next boiled in acid, the edges trimmed to that of the first or female inlay—revolving the stones from the center outward—then polished.

Variations in Method

A method of constructing the first or female section of inlay abutments, is to cast it with the tube in position.

Another method is: Swage in the cavity a piece of pure gold, gage $\frac{3}{1000}$, and make a hole for the tube. Oil the surface of the gold, burnish and swage over it another piece of the same gage of gold. Punch a hole through each side of the second piece with a punch forceps. Boil both matrices in acid and wash them. Secure the matrices together with wax placed in the aperture for the tube. Invest and unite the two matrices with a particle of solder, fused through the two holes that were punched in the sides. Insert the matrix in the cavity and burnish. Add another layer of gold to the matrix in the same manner when the case so suggests. Fit the matrix in the cavity, trim and burnish the edges. Enlarge the hole for the tube, place the tube in position, remove and solder. By this method a perfect fitting edge can be obtained for the first or female inlay.



FIG. 782.

In cases where extensive decay has involved the occlusal surface, shorten the cusps, bevel and cover the edges to avoid the possibility of the tooth splitting (Fig. 782).

Incisors and Cuspids.—The use of the inlay abutment attachment for the front teeth is confined chiefly to upper central incisors and cuspids, and lower cuspids. It is seldom applied to upper laterals and never to lower incisors, as the teeth are too small. To explain the construction, a cuspid will be used as a typical case. An opening is made at the lingual side of the crown in the line of the pulp-canal, the pulp devitalized, removed, the foramen closed with gutta-percha, and the canal filled with zinc oxychlorid. (See Part II, Chapter III.)

The treatment must be so conducted as not to affect the shade of the tooth. (See "Discoloration of Dentin," page 69.)

The cavity in the crown is enlarged and shaped for the inlay and the canal reamed for the tube, as shown in Fig. 783. The side of the cavity approximate to the bridge should be shaped so as to allow as nearly as possible direct connection with it, as indicated at A. To avoid weaken-



FIG. 783.

ing the labial section of the crown, the reaming for the tube should be carried lingually as far as it properly can be and kept within the line of the axis of the tooth. The sides of the cavity must taper slightly to the line of the tube. The edges should have a slight bevel. The canal is reamed to receive a No. 4 or No. 5 tube. Centrals generally take a smaller size. The depth varies in accordance with the size and length of the root, but usually it is from five-sixteenths to three-eighths of an inch.

The first or female inlay is made either by the direct or indirect method. As the process of the formation by either method is about the same, the indirect will preferably be explained. The tube having been fitted to the canal and paralleled, is removed.

To Take the Impression.—Fit and parallel a brass wire in the canal the exact gage of the selected tube. Soften a small piece of compound,

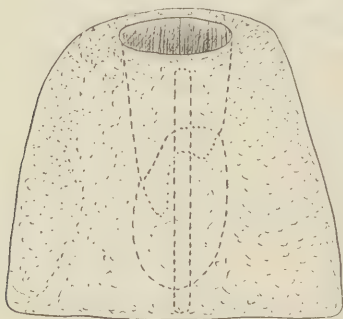


FIG. 784.



FIG. 785.



FIG. 786.

slightly heat the wire and surround it with the compound. Wet the cavity, force the wire to position in the canal, press the compound around the wire, into the cavity and over the edges, chill and remove. An amalgam die is then made. To enable the amalgam to be properly pressed into the impression, embed the impression in a funnel of plaster, as shown in section, Fig. 784. (See page 29.) When the amalgam has set, the wire and compound are removed. The die will be a replica of the cavity and canal.

The surface of the cavity in the die is lubricated, and then wiped with cotton to prevent adhesion of the wax. The tube, mounted on a mandrel, is inserted in the canal, the cavity filled with wax pressed well around the tube, and then trimmed to a uniform thickness over the surface of the cavity, leaving a slight surplus beyond the edge, into which the sprue wire is inserted. The wax is removed, the mandrel seized with pliers, and the tube pushed off the mandrel. The tube is filled with asbestos, the wax model invested, and cast with pure gold alloyed with two per cent. of copper (Fig. 785).

Some practitioners prefer to first cast the matrix inlay without the tube, placing carbon in the wax model instead. After the inlay is cast and fitted, the tube is inserted, invested and soldered in position.

At this stage the work may be fitted to the mouth, to determine its accuracy respecting adaptation and occlusion. The remainder of the construction of the inlay attachment can be done either directly in the mouth or indirectly on the model. The tube is cut off at the floor of the cavity and the inlay trimmed and symmetrically shaped. Enough gold is removed to make space for the supplementary or male inlay, leaving the gold at the edge of the cavity intact, as shown in Fig. 786. The orifice to the tube should be slightly countersunk, and the contraction at the neck from the casting or soldering removed with a dull cone-shape finishing bur. The surface of the cavity and the orifice of the tube are smoothed and polished and a revolving burnisher lightly passed over the surface.

Insertion of the Split Post.—The split post is next fitted in the tube. It should be nearly twice the length of the tube, and fit accurately but easily. The point of entrance of the tube is marked on the post. The post is removed and bent one-thirty-second of an inch farther from the cavity towards the shank than the mark, using a pin bender as already described, page 390.

The Supplementary Inlay.—This is best made by the matrix method. A piece of pure gold plate, gage No. 36, or $\frac{1}{1000}$ to $\frac{1}{2000}$ platinum, preferably the latter, is shaped to the cavity and into the orifice of the tube. When gold plate is used, it is removed and the metal that has been burnished into the orifice of the tube is removed by grinding it on the cavo-side of the matrix, making the hole a little larger than the post, so as to allow it to enter the tube freely. When platinum foil is used it is removed at the orifice of the tube.

The orifice of the tube is vaselined, the matrix adjusted in the cavity, the post inserted in position and the wax melted with a heated spatula into the matrix and around the post. The matrix and post are removed, invested, and the matrix filled with coin gold. The gold should

be drawn around the shank of the post, by heat applied under the investment. After being cleaned in the usual manner, it is adjusted to the inner or female inlay. The edges should be left a little flush until the final finishing when the bridge is inserted. In finishing, stones and polishing points should be revolved outward from the center.

The attachment is now ready for connection to the bridge, to which the shank of the post is waxed, and the wax chilled. The bridge is removed, the tube is held by the fingers, and by pressing on the post with the point of an instrument, the inner or male inlay is released and the bridge with post invested.

Another method for removing the post is to heat the point of a stick of hard adhesive wax and attach it to the metal over the post, chill and pull the post from the tube.

Use of Swaged First or Female Matrix.—Female matrices for incisors and cuspids may preferably be made by the swaging instead of the casting method, using pure gold plate as heavy as the size and shape of the cavity will admit, which varies from gage No. 32 to No. 36, or $\frac{1}{1000}$ platinum. First shape the gold or platinum matrix in a fusible metal die of the cavity taken from the amalgam die, and then transfer it to the amalgam die for finishing. The matrix should be extended well over the margins of the cavity. When a platinum foil matrix is used, it should be reinforced after shaping it to the cavity, by veneering the outer surface with two or three applications of pure gold, readapting the matrix to the cavity between the applications. In this way a most accurately fitting matrix is obtained. To reinforce either a gold or platinum matrix, paint the cavo-surface with rouge, invest and flow a few small pieces of coin gold over the surface. (See "Matrix Gold Inlay," page 228.) The tube is next fitted and soldered in position with coin gold. The subsequent procedure in the construction of the male matrix is conducted the same as with a cast matrix. The matrix method is preferable to casting in the construction of these attachments for small anterior teeth.

Supporting Abutments

This form of support does not demand pulp extirpation. It consists of a lug, with or without an anchorage point, that rests either on the surface of the crown of a natural tooth, or in a countersunk gold filling or inlay, or a socket formed in an artificial crown. It supports and steadies one end of the bridge but does not retain it.

A lug attachment on one end of a bridge, in conjunction with a reliable retaining abutment on the other, is usually sufficient to support a bridge of one or two teeth. On the mandible in conjunction with a

retaining molar abutment it will in many cases afford additional reliable supports to a bridge of two and occasionally three teeth. It can also be used to furnish additional support to a large bridge with two or more retaining abutments.

In teeth with vital pulps, the cavity should be made large enough without impinging on the pulp to accommodate the lug and allow a substantial lining of gold between it and the walls. To prevent displacement, an undercut form should be given the cavity for a filling, and a retentive form for an inlay. As retentive a form as possible should also be given the lug. As the lug will be adjusted and removed in an occlusal direction, calculation should be made accordingly.

The cavity in a cuspid is usually given the form illustrated in Fig. 787. The filling or inlay may be slightly exaggerated in contour by



FIG. 787.



FIG. 788.

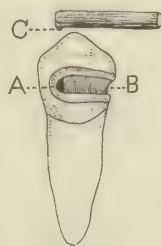


FIG. 789.

expanding its bulk, as illustrated at A, Fig. 788, by extending it over the margin of the cavity, to increase the depth of the slot for the lug. If a filling is used it should be made entirely of cohesive gold foil thoroughly condensed. When an inlay is used, the slot for the lug may be cut in the inlay after it is cast, or a depression may be made in the wax model, and the slot shaped additionally after the casting. The lug is made of clasp gold wire, gage 12 to 14, the gage being regulated by the size of the tooth and the stress it will have to withstand. Usually some trimming of the wire is necessary.

A slot in a filling is best cut by first drilling an indentation in the center or slightly past it on the lingual side (A, Fig. 789), close to the bottom of the cavity with a spear-pointed drill, and then shaping it with a pear-shape bur to the size of the wire used. A slot (B) is cut the same size as the hole, from its orifice to the side of the filling or inlay. The removal of gold for the slot should be so conducted as not to weaken the efficiency of the filling or inlay.

The point of the wire lug is slightly rounded and the end bent at a right angle and filed (C) so that the point rests in the indentation at the end of the slot. The shank of the wire lug is made long enough

to extend to the backing of the adjoining dummy, so that it can be soldered under the cusp-cap, if one be present.

In bicuspid and molars with vital pulps, the cavity of the filling or inlay is extended about two-thirds or three-fourths across the occlusal surface, and down on the side approximately to the bridge, so as to give such a length to the filling or inlay as will admit of a proportionate length to the wire lug, as shown in Fig. 790. Bicuspid do not admit of the use of a large wire lug except when pulpless. A much more substantial wire lug can be applied to molars.

To fill in the space on the sides and around a wire lug and anchorage point so that there shall be no perceptible seam: Burnish a matrix of $\frac{1}{2000}$ platinum foil in the groove, and fill the matrix with wax before or after the lug is attached to the bridge. Warm the wire lug and press it

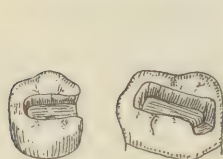


FIG. 790.

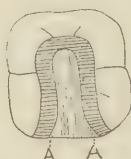


FIG. 791.

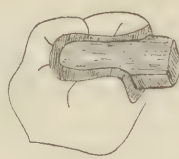


FIG. 792.



FIG. 793.

to position in the wax of the matrix, remove, invest, wash out the wax and melt hard solder in the matrix around the wire lug, trim and adjust. The additional metal increases the size and strength of the lug and causes it to assume the form of a supplementary inlay. If the cavity in the inlay is given the slight retentive form seen in Fig. 790, the lug is rendered additionally secure.

The greatest stress on a support of this form is on the part that spans the space between the bridge and the entrance to the slot of the abutment. This portion can be reinforced quite effectively by flaring the entrance to the slot, as shown at A, A, Fig. 791, burnishing the platinum matrix to the flare, and extending the matrix under the lug to the pontic, then investing and filling the matrix with solder. Fig. 792, shows the reinforced attachment finished in the matrix of the molar, and Fig. 793 the same in a bicuspid.

A socket for a lug attachment in a gold crown is described on page 305, Figs. 583 to 586 inclusive.

Special Forms of Attachments

Flanged Collar Attachment.¹—This is a form of attachment made to fit over a gold crown. It can be, but is seldom used on a natural tooth.

¹ This form of attachment was introduced by Dr. C. M. Richmond.

For the gold crown, the sides of the tooth are to be shaped straight and parallel to the sides of any other supporting crown or line of attachment. A straight-sided gold crown is made and fitted. The gold crown is removed, a strip of paper wound around it, and fusible metal melted and poured into crown and paper tube. This forms a die of the crown with a shank as seen in Fig. 794. In this attachment the entire edge of the collar is bent over on the occlusal surface of the crown and thereby supported in position (Fig. 795).

The collar is made entirely of clasp gold, gage No. 28 for molars and No. 29 or 30 for bicuspid. The process is as follows: An accurately fitting collar is first made. The collar is then, by tapping with a small horn or copper hammer, aided by frequent annealings, shaped on the gold crown or a die of the tooth. The flange section can be slightly thinned and tapered with a small carborundum wheel, and then tapped over the occlusal edge.

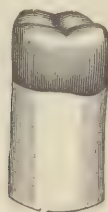


FIG. 794.



FIG. 795.



FIG. 796.

This collar attachment when applied to a natural crown with a vital pulp is best first shaped on a die of the tooth, then placed in a swage and swaged to its exact form. Constructed as described this attachment is superior to one that is cast in that it possesses resiliency and is less bulky.

Lug Collar Support.—Fig. 796 illustrates a form in which a straight-sided removable collar is maintained in position by a lug on the side of a gold crown. Trimming the lug or edge of the collar will at any time permit the denture to press more forcibly on the tissues.

The Split-bar Attachment

This attachment is used as a retaining abutment. Its merit is that it does not require paralleling of the sides or canals of the abutment teeth. The roots consequently are not weakened by reaming as in the use of tubes with split posts. A split-bar attachment is a form not much used as it is intricate in construction and demands pulp extirpation of normal teeth. Its use is best confined to pulpless cuspids.

Construction.—Applied to a cuspid porcelain-faced crown, the root is capped with a post in the canal. A detachable porcelain facing that allows space for the box of the split-bar is ground to position on the cap and attached with wax. A removable matrix of plaster is placed on the labial side of the facing or crown, as shown in Fig. 797. The facing is removed, backed, replaced in position and the backing attached to the floor of the cap with a particle of hard solder.

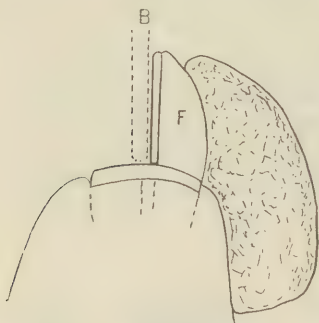


FIG. 797.—B, Position box is to occupy; F, porcelain facing.

The Split Bar.—The split bar is made of iridio-platinum plate, by evenly doubling on itself a piece of the plate, gage 23, about one and one-quarter inches long and three-eighths inch wide. The two ends of the plate are first brought together the same as in the construction of a split post, and then gradually at the sides, frequently annealing. When the sides nearly touch a film of mica is placed between and they

are brought in close contact by swaging in a No. 2 swager. The split bar then assumes the thickness of gage 17 (Fig. 798).

The line of the cervical side of the split bar is filed at an angle of 8° from the open to the closed end as shown at A, Fig. 799, and at the open end at an angle of 16° from the cervical to the occlusal side as shown at B.

The Lug.—The lug is made of a V-shaped piece of the same plate as the bar, each side of which tapers 8° to a point. The extreme point is

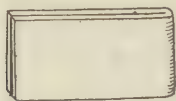


FIG. 798.

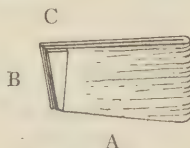


FIG. 799.

removed and the lug adjusted to the bar on the lingual side as seen at C, and soldered to position, using very little solder. The edges having been trimmed and polished the bar is ready for the box.

The Box.—A strip of 32-gage platinum is adapted to the *level* side of the bar and brought around and extended against the open end and lug as indicated at D, Fig. 800, viewed from the occlusal side. A shorter strip is adapted on the other side to and up against the side of the lug slightly extended above its surface (E). A piece of the plati-

num plate is fitted to the space over the lug, attached with wax, the parts removed, invested and soldered with platinum solder. It is then fitted on the bar, the edges trimmed, the floor fitted, sides and floor removed, invested and soldered. The box is adjusted on the bar, the surplus plate removed, the edge smoothed, when bar and box are ready for application to crown (Fig. 801).

Application.—The box is mounted on a mandrel and paralleled in position on the crown. The box is attached with wax, the mandrel

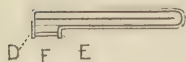


FIG. 800.



FIG. 801.



FIG. 802.

and porcelain facing removed, the box invested, a flat piece of graphite with a long shank being inserted with investing material in the box—and box united to crown with but a small quantity of solder. The lingual side of the crown is contoured with inlay wax, the wax model removed and cast in 22-carat gold. The casting is placed in position on the crown, attached with wax, invested and united with solder.

The split bar is next fitted into the box. Some trimming is usually necessary to make allowance for slight changes resulting from the manipulation of the box and soldering (Fig. 802).



FIG. 803.

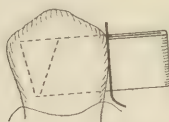


FIG. 804.



FIG. 805.

The Shield.—This consists in the placing of platinum plate penetrated by and attached to the split bar, against the approximal surface of the crown. In the construction it acts as an approximal surface for the adjoining bridge-tooth (pontic) and forms a dividing line in uniting the bar to the bridge. It is made of a piece of platinum plate, gage No. 38, about three-sixteenths inch wide and one-fourth inch long (Fig. 803). The contour of the crown approximal to the split bar is beveled slightly to the line of the insertion and removal of the bar. The platinum plate is perforated to admit the split bar, and adapted to the

side of the crown with the split bar in position in the box (Fig. 804), the platinum attached to the split bar with wax, split bar and platinum are removed and invested, as shown in Fig. 805, and united with hard solder. At the same time solder is flowed into the slit between the exposed ends of the split bar, to unite them and thus permit the split bar to be shortened without separating the bars, as they are only united at the end where the strip was bent.

T-shaped Attachments

Attachments of this shape are extensively used. They occupy a small space and are mostly inserted in inlays and cap-crowns for teeth with vital pulps.

T-shaped Loop Attachment

This form is much used, because it is reliable as a retaining abutment. It consists of a flattened loop that fits into a correspondingly shaped socket. It is usually made in three sizes: Small, medium and large.

Construction.—A strip of 24-gage clasp plate is cut about three-sixteenths to one-fourth of an inch wide, fully an inch long. The



FIG. 806.



FIG. 807.

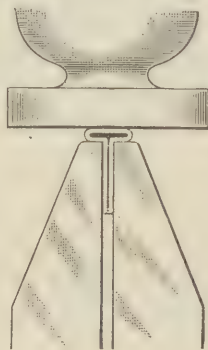


FIG. 808.



FIG. 809.

width and length of the strip are regulated by the size of the intended attachment.

The strip of plate is annealed and bent around the mandrel point of the pliers shown in Fig. 806. The extended ends are pressed together with the fingers and then with square-beaked pliers. The loop of plate when removed has acquired the form shown in Fig. 807.

The ends of the loop are next inserted in large flat-beaked pliers with the loop resting against the flat ends of the beaks. The handles of the pliers are held tightly while the loop is flattened to its surface with taps

from a flat-surfaced hammer evenly delivered, at first light and then harder until the loop is brought level, Fig. 808. Before the loop is brought close together a film of mica should be inserted to subsequently prevent invasion of solder.

If the work has been properly conducted the loop will have assumed the form of a T, as seen in Fig. 809. The sides of the loop and shank must be perfectly parallel and the shank of the loop directly in the center. The edges of the loop are leveled with a fine flat-sided file and burnished. The attachment is then ready for the formation of the box.

The box is made by adapting around the attachment a strip of 36- to 38-gage platinum plate about one-fourth of an inch wide, then adjusting against the bottom a piece of the same plate, removing and uniting it with a particle of pure gold as shown in Fig. 810. The box and attachment are located in the wax inlay model with a parallelometer, removed and the inlay cast. The inlay is fitted in the model, the box again placed in exact position with the parallelometer and cemented with wax in the inlay with solder. In investing a portion of the investment material should be placed in the box and then a loosely fitting piece of carbon with a large shank inserted. The shank of the carbon is to be embedded in the investment to hold the box in position during the soldering.

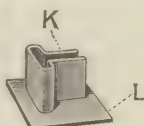


FIG. 810.

Doxtater Method of T-shaped Attachment Construction¹

By this method a specially designed mandrel and tools are used to shape the attachment to secure accuracy of form. The following is a description.

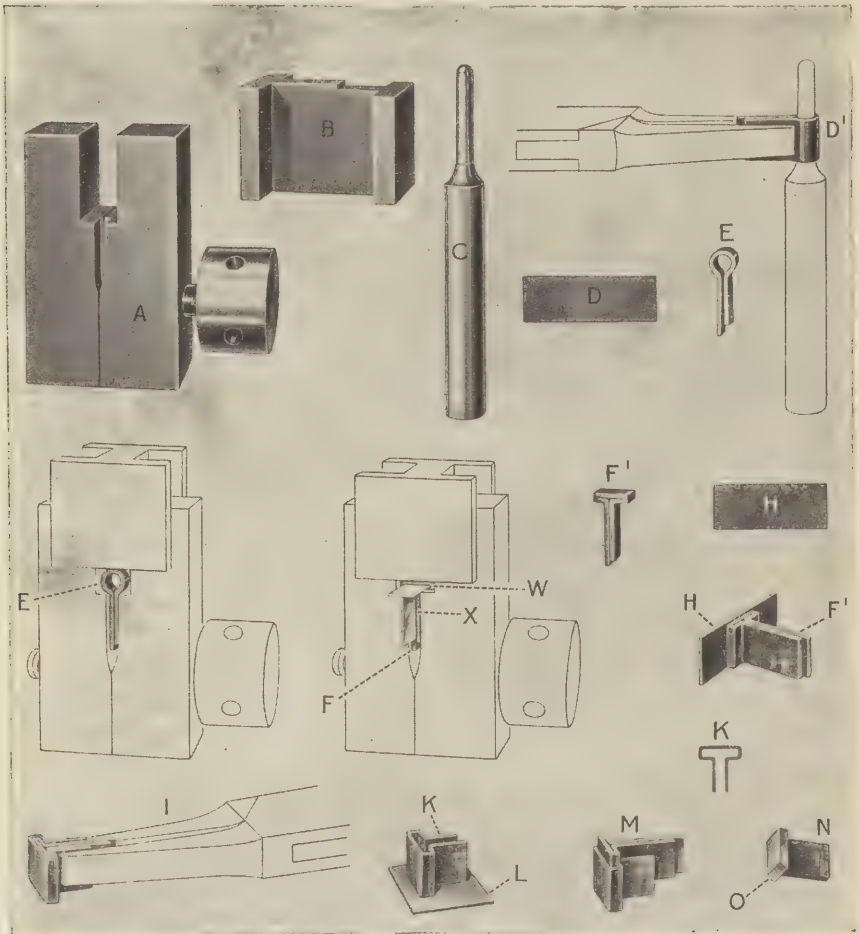
The tool for making attachment is of three parts as shown in Plate III. Split swaging die A, which is opened and closed by a set screw; swaging block B and mandrel C. Three sets are used, large, medium and small.

Cut a strip of clasp plate, 26 gage, one-fourth of an inch wide and at least three-fourths of an inch in length, as at D. Polish burred edges with paper disk. Anneal, metal. Select a mandrel from the swaging outfit either large, medium or small as required. Bend the strip of metal around the mandrel, which is held at its center until the ends meet. With a pair of flat-nose pliers grasp the outside portion of the metal as close to the mandrel as possible and with considerable force press it around the mandrel until the metal hugs the mandrel tightly (D). Considerable care should be exercised

¹ The description given is from an article of Dr. LeRoy W. Doxtater explanatory of his method.

in this step because the circumference of the mandrel and the thickness of the metal will form a loop (E) which when subsequently flattened will completely fill the space allotted to it in the swaging die; therefore, care must be exercised that the loop fits the rod closely when the pliers

PLATE III



are closed. It may be necessary to vary the metal .001 of an inch. Metal rolled to .016 of an inch, which is approximately 26 gage, will just fill the space in the swaging die. Take the metal off the mandrel and anneal. The metal is now shaped as at E and is placed in the swaging die. Close swaging die with set screw and place the swaging block

over the metal and flatten as at F. The metal should be removed and annealed two or three times during this operation. Place thin mica in spaces W and X before final swaging. Remove from swaging die and the metal will be found formed as at F. Trim away excess mica and file the edges smooth with fine flat file and polish the edges.

Making the Box.—Cut a strip of pure platinum of approximately 34 gage in thickness, one-fourth of an inch wide and a little shorter than the length of the original strip of metal as at H. Place the male attachment (F) flush against the center of the platinum (H) and bend the platinum up against the sides of the male attachment. Grasp the ends of the platinum with smooth-beaked pliers and force snugly against the sides of the male attachment (I), then burnish the platinum to the sides of the male attachment until a perfect adaptation is secured. The attachment with its platinum sheath is now placed in a smooth hand vise and the edges are filed smooth and polished.

Remove the platinum without distorting it. This can be done by grasping the extending end of the male attachment with Bernard pliers, and at the same time pulling downward with the fingers of the left hand on the platinum sheath. The platinum is then formed as in K. Next select a piece of perfectly flat platinum 34 gage (L) for the floor. Place the platinum sheath (K) on the floor (L) and solder with platinum solder. Trim away the excess platinum used in making the floor and the attachment with box is complete. M shows attachment part way out of box. N shows male attachment beveled at O. This shape is given the attachment when it is placed close to the cervix so as to take less space.

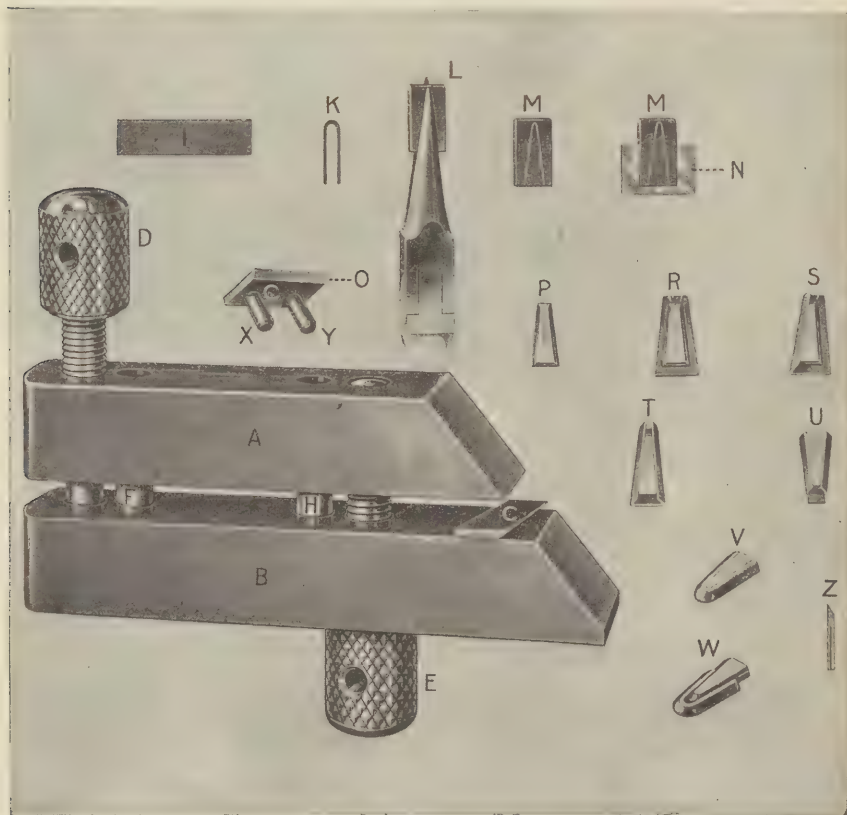
Doxtater V-shaped Attachment

The tool for making this attachment as shown in Plate IV is a steel clamp filed at its beak at an angle of 45° . It consists of three parts A, B and C. The parts A and B are held together by two set-screws D and E and two dowels F and H. The small blade C is filed at an angle of 45° at O and is held in position by the dowels X and Y. When in position on the clamp it forms a V-shaped space which conforms to the pattern of the male part of the attachment.

The Attachment.—Cut a strip of clasp plate three-sixteenths of an inch wide and three-fourths of an inch in length (I). Bend double (K), anneal and flatten between the beaks of a pair of pliers (L). Mark outline of beak of pliers in the center of the metal (M) to establish a guide for filing when placed in clamp. Place mica (N) about three-fourths of the distance between the two parts of the bent metal (M), and fill in the open space with 22K solder. Trim away excess of mica.

The metal is now ready for shaping the male part of the attachment. Remove the small blade (C) from its doweled place and insert the metal with line formed by beak of pliers on a line with the beak of the clamp. Tighten the set-screws D and E. File off the extending portion of metal and polish the edge, thus making a 45° angle on one side of the male attachment. Open the clamp. Replace small blade

PLATE IV



(C), and place filed part of male attachment flush against the angle of the blade (C). Tighten clamp and file off the extending portion of metal. The male part of the attachment is now complete as seen at P.

The Box.—Cut a piece of 30-gage pure platinum large enough to cover the male part with overlap as at R, also cut the platinum on an angle toward the small end of the male attachment, as shown by white lines in R, in order to form an overlap as shown at U. Remove blade

(C) from clamp and place platinum and male part in clamp. Close clamp with edge of beak on a line with top part of male attachment. Burnish platinum flush against 45° angle of male attachment. Remove from clamp. The platinum with one edge turned up at an angle is seen at S. Trim away excess platinum. Replace blade (C) and place male attachment with burnished side of platinum flush against blade (C). Tighten clamp and burnish the other side of the platinum to the edge of the male attachment. Remove from clamp and cut away excess platinum. The platinum box is now burnished to both sides of the male attachment (T). Cut off the sides at small end as seen at U. Burnish the overlap up against the male attachment. Remove the male attachment and solder the overlap of the box with platinum solder. V shows the male attachment and box complete. W shows male attachment part way out of the box and Z shows the male attachment beveled at

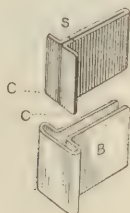


FIG. 811.

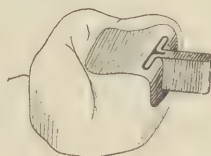


FIG. 812.



FIG. 813.

the end to avoid removal of tooth structure at the cervical section when the cavity is too shallow to accommodate the attachment and the dentin is sensitive. A piece of clasp plate about 19 gage is soldered to the male portion of the attachment as a shank to attach it to the bridge.

T-shaped Plate Attachment.—This is simple in construction and application. It is made by doubling on itself a strip of clasp gold, gage 22, clamping it in a vise and bending the extended ends outward as shown in Fig. 811. A piece of thin mica is placed in the slit as far as S, and the end of the shank is soldered together, using solder filings or an atom of hard solder. A box is made of platinum, gage No. 38, as illustrated at B. The box is paralleled to the other abutments and either inserted in the wax model of the inlay and embedded in the casting, or soldered in a slot provided for it in the inlay. Fig. 812 shows this attachment in an inlay in a molar. The corners and edges of the wings at C C are slightly rounded. By slightly expanding the center or by bending the wings, the friction is increased. As this attachment is flat and small in size, it may be used when proximity to the pulp limits the available space.

To prevent invasion of food into seams of any attachment of this style in mastication, an oval-shaped plate may be placed over the flanges made of platinum, gage 38, or 22-carat gold, gage 30, as shown at C, Fig. 813. The plate is united to the bridge and flanges and reinforced with solder. A thin sheet of mica placed between the plate and the wings of the flanges will obstruct the solder at that point if it is desirable to leave the wings free.

T-shaped Double Plate Attachment

This differs from the preceding form in that it is made of two layers of plate instead of one.

Construction.—Cut two strips of 26-gage clasp plate, one about one-sixteenth of an inch longer than the other, shape the short strip as shown in Fig. 811 and next shape the longer strip closely over it. Insert a film of mica in the slit of each of the wings, also a film in the center slit to the point M, in Fig. 814, and unite the layers of plate forming the shank to that point using a small quantity of hard solder. Trim and finish the edges of the plates evenly.

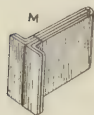


FIG. 814.

The box is made of platinum and applied similar to one shown in Fig. 811. The corners of the attachments that enter the box are then slightly rounded. In use the attachment is tightened in the box by slight expansion of the slit in the center or those in the wings—the shank being made of four layers of clasp gold makes a strong connection to the bridge.

Dovetail Lug and Split-post Attachment.—This attachment is shown on the side of a gold crown in Fig. 815. It consists of a dovetail lug that fits into a socket (B) in the adjoining bridge tooth. A split post (C) fits in a tube in the dovetail lug. The form of the lug locks the bridge tooth and consequently the end of the bridge to the gold crown, while the split post secures the dove-tail lug in position. The dovetail form of the lug relieves the split post of lateral stress.

The dovetail socket with the tube hole (D) is first made by shaping a wax model of the form of the dovetail lug, around the tube, investing and casting. It can also be made by filing a piece of fusible metal to the form and size of the dovetail lug, then shaping a thin piece of platinum plate over it, placing the tube supported with wax in position in the shaped plate, investing, melting out the wax, and either by soldering or the casting process, filling in the space between the tube and the plate with coin gold.

The split post (E) is next fitted in the tube. The point of the post is

best extended at least one-sixteenth of an inch through the end of the tube. The lug is next soldered to the crown, a platinum box formed around the lug, the post soldered in the box, and post and box soldered in position in the bridge tooth. Both lug and post must be aligned with the other abutment. This attachment is of a design suitable to apply to a gold crown on a tooth with a vital pulp.

Solid Post and Tube Attachment.—This consists in the use of a solid post of clasp gold, gage 15 to 17, in the tube instead of a split post. Fig. 816 shows the attachment applied in an inferior bicuspid gold crown. It can be advantageously used in roots too small, or too long and narrow to properly receive a tube and split post. In the use of a solid wire post

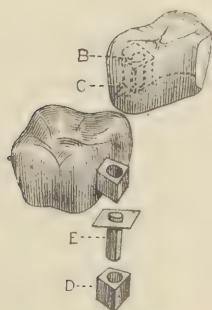


FIG. 815.

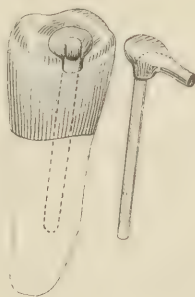


FIG. 816.

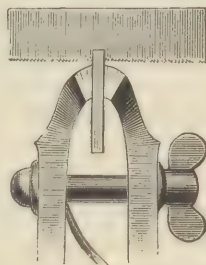


FIG. 817.

a short slit may be cut in the extreme point with a very thin-saw-edged separating strip, as shown in Fig. 817. The slit point is then pinched together and burnished. By slightly opening the slit, or slightly bending the post at any time, more friction is created.

Comparative Values of the Several Forms of Attachments

The form of attachment used in removable bridge-dentures, constitutes an all-important factor, for on it depends the success of the operation involved. Therefore a knowledge of various forms of attachments in use and a study of their practical value in different positions and under various conditions, is essential in their application to what are considered at the present time the most approved styles of construction in removable bridge dentures. An impartial discussion of the relative values of the several removable bridge attachments analytically considered respecting application construction is here given.

Retaining Attachments

Tube and Split-post Attachments.—This is one of the most reliable of all the attachments for retaining power. This retaining power depends on the amount of friction obtained in a given space and is proportionate to the length and size of the split post.

Telescope Gold Crown with Tube and Split-post.—This is one of the most reliable for posterior teeth.

Tube and Split-post Porcelain-faced Crowns.—These are used on anterior teeth. The amount of retaining power of this form of abutment is dependent on the friction of the post in the tube, as the half-collar only tends to steady the crown. The retaining power of such an abutment therefore is proportionate to the gage and length of the tube and split post.

Split-bar Attachment.—This form possesses the advantage for a cuspid crown in that it can be tipped at any angle necessary to parallel it to any other abutment.

Retaining Inlay Attachments.—The retaining power of the inlay attachment is dependent almost entirely on the friction of the split post in the tube inserted in the inlay. As a retaining abutment it may be classed as next to anterior tube and split-post collar crowns. It admits of considerable deviation from the vertical in paralleling other abutments when inserted in molars but not in centrals, cuspids or bicuspid.

Other Forms of Retaining Attachments.—The respective merits of clasps with lugs and other forms of retaining attachments are stated in connection with the description of their construction. (See pages 441 and 456.)

Manufactured Retaining Attachments.—These are described on page 462. They furnish a variety of forms of attachments.

Supporting Attachments

Telescope Crown.—This form is classed as a supporting abutment, as it cannot always be relied on as retaining, especially on a superior molar or bicuspid. On the mandible enough friction may be obtained to retain it when applied to a small bridge extending from the first bicuspid to the second molar, if the inner crown is made long and only slightly cone-shape in form. A telescope crown usually is best applied as a supporting abutment in combination with one that is retaining. When the axis of a tooth is greatly out of line the use of a telescope crown is contraindicated in favor of a more suitable form of attachment.

Supporting Lug Attachment.—A lug extended from a pontic to rest on the lingual surface of an adjoining central or cuspid, resists stress in a labio-vertical direction. If inserted in a socket in an inlay or filling, the resistance effected is more vertical. A lug resting on the occlusal surface of a bicuspid or molar resists stress mostly in a vertical direction, but when inserted in a socket in an inlay or gold crown it also acts laterally. When the socket is slightly oval or the lug dovetail shaped in form, additional resistance in either a distal or mesial direction is obtained. Such a form of lug in combination with a clasp usually constitutes a reliable retaining attachment applied to a saddle denture.

CHAPTER II

CONSTRUCTION OF REMOVABLE BRIDGE-WORK

Peeso Method¹

1. Determine the most suitable teeth and roots to use as abutments by examination of the case in the mouth and study of plaster models of the same, as described in the preceding chapter.

2. Have radiographs taken of the teeth or roots selected as abutments, to positively determine their suitability and also as a guide in their treatment.

3. Perform such necessary preparatory treatment of teeth and roots as is required, and shape coronal sections and crevices properly. Guided by the eye and study of the model and radiographs of the roots, ream and parallel the root-canals that are to receive the tubes, and fit in each of them the intended tubes mounted on mandrels. The mandrels should be of a length that will permit their insertion in proper position and the taking of an impression. Encircle each tube on its mandrel with a mark to show how far it enters the root or tooth. In reaming canals for tubes the rule to follow is: Ream the larger canal to the line of the smaller as the smaller allows the least lateral reaming, whereas for instance a molar permits considerable lateral placing of a tube.

In paralleling canals to place the tubes, it will be found necessary in many cases to ream one or more of the roots considerably away from the central section or line of the pulp-canal, using the Peeso reamers (Fig. 818). Such reaming, if done at the orifice of the canal in the case shown in Fig. 819, will frequently leave but a small quantity of tooth structure at one side, as illustrated in the diverging lines of the canals. The reaming that would be necessary to so parallel if confined to one root is shown in Fig. 820. To avoid weakening the root at the point A by this excessive reaming, the line of the space for the tubes is carried a little to one side in each canal and the amount of necessary reaming at the orifices of the canals is proportioned between the two

¹Dr. F. A. Peeso.

roots, as shown in Fig. 821. In reaming canals of abutments on opposite sides of the mouth, the relationship bucco-lingually, as well as laterally, is also to be considered.

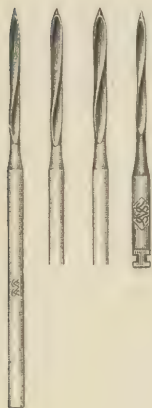


FIG. 818.

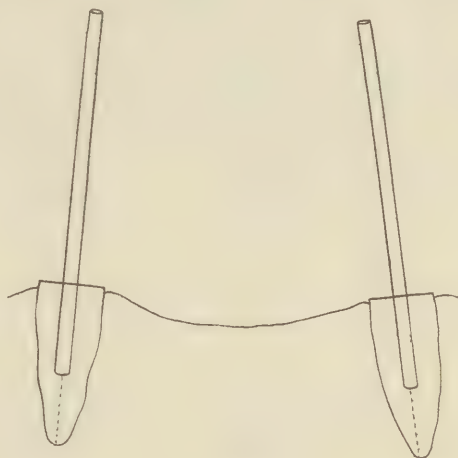


FIG. 819.

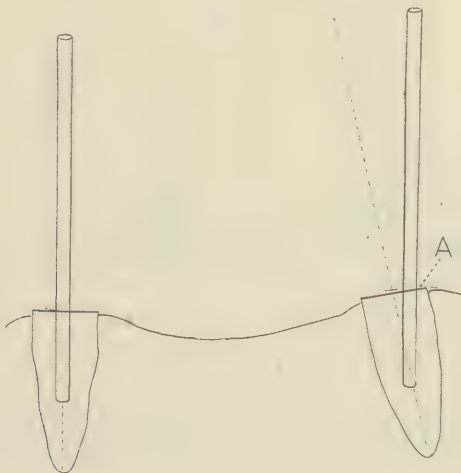


FIG. 820.

In the construction of removable bridge-work the abutment roots and crowns that carry collar attachments require to be shaped parallel to each other, also to the line of attachments, such as tubes and split posts and all forms of attachments that directly enter abutments.

The typical case used in describing fixed bridge-work will be utilized to describe the construction of removable bridge-work. A tube and split-post crown with a porcelain facing will be used on the cuspid and a telescope crown with split post on the molar. A No. 4 tube is indicated for the cuspid and a No. 5 tube for the molar. In accordance with the methods described, the cuspid root is first reamed for the tube and then such reaming in the molar as is indicated by the eye as necessary to parallel the molar tube to the one in the cuspid. The tubes mounted on mandrels are next encircled with a mark to indicate their depth in the canal.

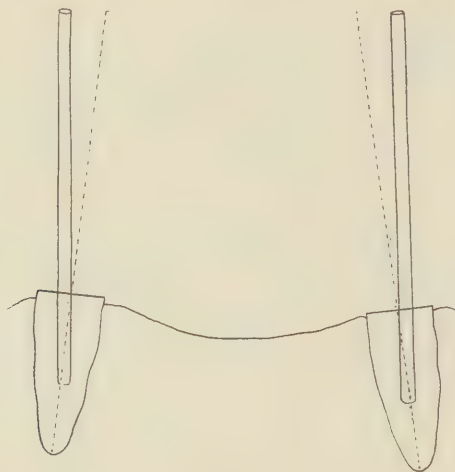


FIG. 821.

The abutment cuspid root and molar crown are trimmed and shaped for gold collars so that the collars will move on and off in corresponding parallel lines with each other and the mandrels. This is done first by paralleling the sides of the abutments and then slightly tapering them in the occlusal direction (Fig. 822). Next make the gold collars. Leave each collar a little longer than is required so that it can be more easily removed in the impression (Fig. 823).

Place the collars on the cuspid root and molar crown and insert the tubes mounted on the mandrels in the same previously paralleled position in the canals and secure the tubes in the collars with wax (Fig. 824). Take a plaster impression, removing the collars with the tubes on the mandrels. Varnish the surface of the plaster impression and outer surface of the tubes, veneer the cavo-surface of the caps with paraffin and run an artificial stone model. When the artificial stone is

set remove the plaster impression and the resultant model will be a replica of the condition in the mouth with the tubes on the mandrels. Remove the tubes with the mandrels, which is facilitated by heating both mandrels and tubes, and cleanse the tubes.

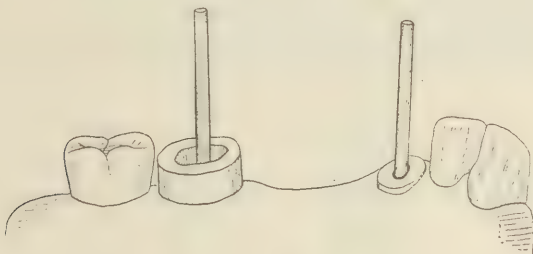


FIG. 822.



FIG. 823.

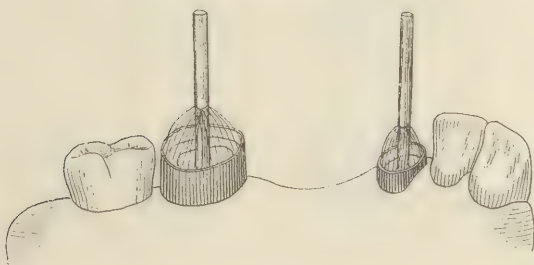


FIG. 824.

The Paralleling Staple.¹—Select straight brass rods three to five inches in length and of a gage such as will fit, or by turning down in a chuck on the lathe, can be made to fit the tubes. The tubes on the ends of the brass rods are inserted into the holes on the model. The extending ends of the brass rods will plainly indicate any divergence from parallel lines should it exist, as shown in Fig. 825. Such divergence is corrected by removing the rods and tubes, and reaming the holes in the

¹ The use and construction of a paralleling staple ought to be first taught students in the opinion of the author and then that of a paralleling device.

model, guided by the radiographs of the roots and the marks made on the tubes to indicate their depth in the roots.

When the brass rods appear to be properly paralleled, they are tested by cementing the tubes with wax on the model and removing and replacing the rods, either by holding the ends together or cementing a cross-bar with hard wax. When there are three or more rods, two are first joined together and then the others connected to them.

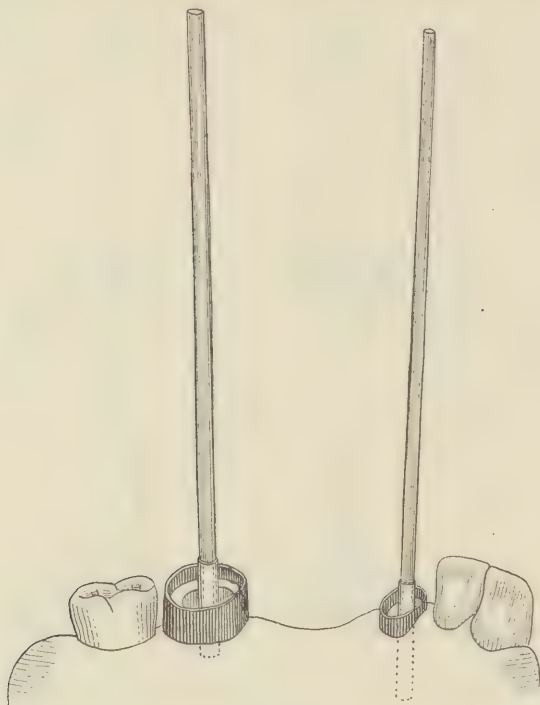


FIG. 825.

The rods having been paralleled, are retained in relative position with two cross-bars cemented with wax cement (Fig. 826). They are next removed from the model, each rod separately seized with a small hand-vise or pliers and the tube pushed off with an instrument (Fig. 827). The rods are then invested and the wax washed out. The cross-bars will fall off when the wax is removed. Two short cross-bars are then fitted in between the brass rods, about three-fourths of an inch from the points of the rods as they enter, and one-fourth of an inch apart. The investment is heated and the rods joined together with

silver solder. The excess length of the rods is then cut away, leaving them in the form of a staple projecting about three-eighths of an inch beyond the line of the molar collar so that when later placed in the mouth the staple will not interfere with the taking of the impression (Fig. 828).

The staple is placed back in the tubes on the model to verify its accuracy, and at the same time the collars are carefully examined to see if they parallel favorably with the rods of the staple, as the rods

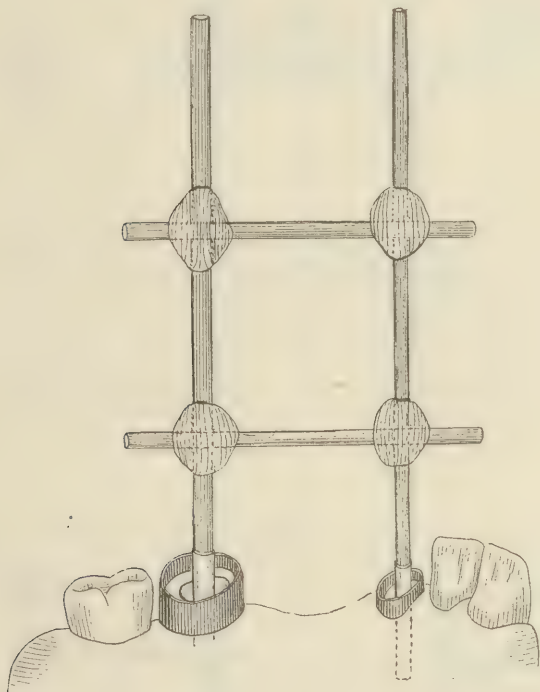


FIG. 826.

indicate the ultimate position of the tubes (Fig. 829). If the collars are not parallel with the brass staples they must be made so.

The tubes mounted on the staple are next adjusted in the canals in the mouth and any necessary additional reaming done. The collars are removed from the model, adjusted in the mouth, trimmed to the surfaces of the abutment roots or teeth and the floors soldered on. Holes for the tubes are then made in the floors with drills, and enlarged with burs sufficiently to allow the tubes on the staple to move in and out freely without touching the floors.

The caps are placed in the mouth, the staple with tubes inserted, and wax pressed in the opening in the floor around the tubes. Plaster

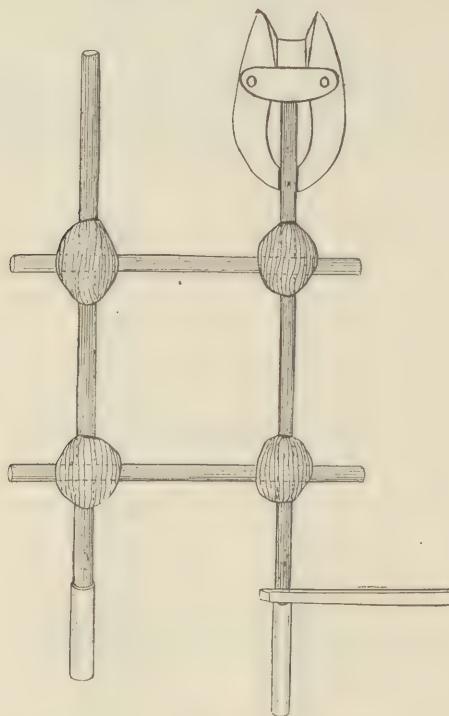


FIG. 827.



FIG. 828.

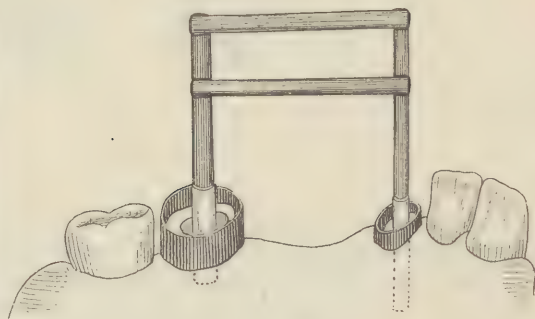


FIG. 829.

is separately placed on each tube and cap abutment and all removed. The rod of each staple is next grasped with a small vise and by pressing on the end of the tube with a small chisel, the tube and cap are pushed

off the rod. The tubes and caps are each invested, plaster on floor of cap removed, asbestos packed in the tubes and the tubes united to the floors with 20-carat solder. The solder should be flowed down into the opening around the tubes in the floors. The ends of the tubes are next trimmed level with the surface of the floors.

An outer cap with a split post is next made for the cuspid and a telescoping cap with a split post for the molar, with the slits of the posts placed in a linguo-buccal direction (Fig. 830).

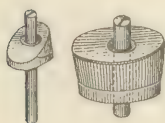


FIG. 830.

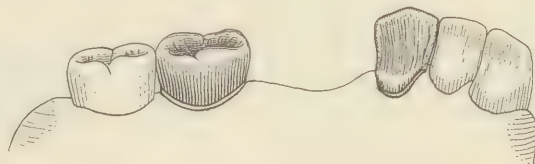


FIG. 831.

All the parts are placed in position in the mouth and an impression and "bite" taken with plaster as for fixed bridge-work (see page 283). The cavo-surfaces of the caps and the outer surfaces of the tubes are veneered with paraffin and models are made and mounted on an articulator. The occlusal cusps of the molar and the porcelain facing of the cuspid are added in accordance with the antagonizing teeth (Fig. 831). The bridge teeth (pontics) are next constructed and united to the outer caps of the abutment crowns.

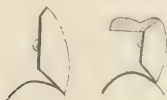


FIG. 832.



FIG. 833:



FIG. 834.



FIG. 835.

In removable bridge-work, if a saddle is not used, the bases of the artificial teeth (pontics) are generally made to rest closely on the membrane of the alveolar ridge. For this purpose the surface of the plaster model is slightly scraped and a piece of platinum foil or pure gold plate adapted over the surface. The bases of the porcelain facings are ground with a narrow V-shaped space at the cervico-labial side, and backed, as illustrated in Fig. 832. This space is to be filled with gold in the soldering, and when finished appears as shown in Fig. 833. The metallic section of such a pontic can be made entirely of gold by the casting process and the porcelain facing then cemented to place (Fig. 834), as described in relation to replaceable incisor facings (Fig. 835). (See page 297.)

Fig. 836 shows the completed removable bridge.

In removable bridge construction, the contraction of gold in soldering must be more carefully considered than in the fixed form, as the alignment of the parts, especially the tubes and split posts, is easily affected. For this reason, the soldering should be done in sections and the sections then united in a final soldering operation. The pontics should be formed first, next they should be soldered together, and then united to the outer caps of the abutment crowns or their attachments. In the typical case shown in Fig. 836, the bicuspid pontics were made in this manner.

In the construction of removable bridge-work, the correct readjustment of caps, crowns or pontics that are removed from the model can be assured by the use of a removable plaster matrix. (Figs. 525 and 797.)

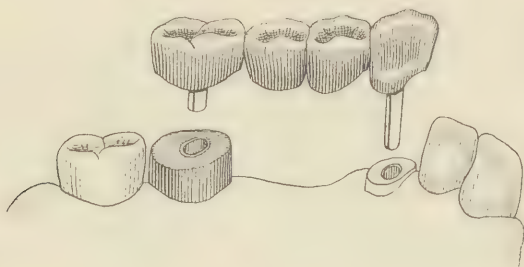


FIG. 836.

Removable Bridge Extending on Both Sides of the Mouth.—In the case illustrated in Fig. 837, the two cuspid roots, right second molar and left first molar, are the abutments. Split posts and tube crowns with porcelain facings are made for the cuspids, a telescope crown with split post for the right second molar, and an inlay with split post for the left first molar. The pulps of the four abutment teeth are devitalized and the root-canals filled.¹

Construction.—Ream and parallel root-canals to receive tubes and fit the tubes on the brass rods into them. Trim and shape the cuspid roots and molar so that caps will move on and off in line with one another, parallel with the brass rods, and shape the cavity in the left first molar for the inlay attachment, as described on page 293. Have the line of the side walls of the inlay cavity parallel and slightly tapering with that of the rods and sides of the other abutments, so that the inlay can be removed with them when an impression is taken. Next make

¹ Same as case shown in Fig. 561.

the abutment gold collars and the matrix section—female inlay—for the inlay attachment in the molar with a hole for the tube.

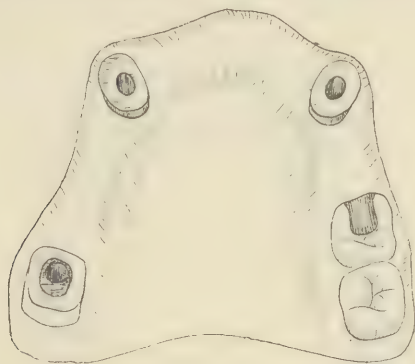


FIG. 837.

Place the gold collars on the abutments and the gold inlay matrix in the cavity of the molar in the mouth, and insert the mandrels or if preferred the brass rods with the tubes in the canals, surrounded with wax packed in the collars and inlay matrix (Fig. 838), and take an

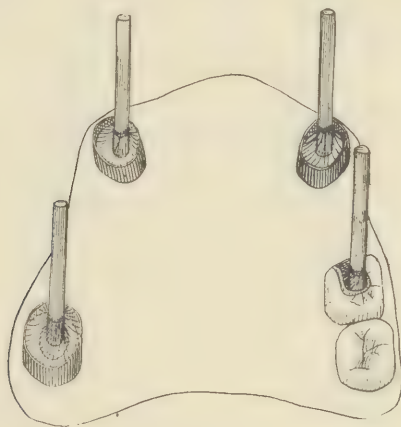


FIG. 838.

impression in plaster, removing in the impression the collars, inlay matrix and brass rods with the tubes.

Veneer cavo-surface of inlay matrix with paraffin, also the inside surface of the caps, varnish, oil and make a model, as already described.

Next form a paralleling staple, as previously described, to accurately

parallel the several tubes, which is very necessary in this case. Place the rods of the staple in the tubes and examine the collars to see that they are favorably paralleled with the tubes on both sides of the mode

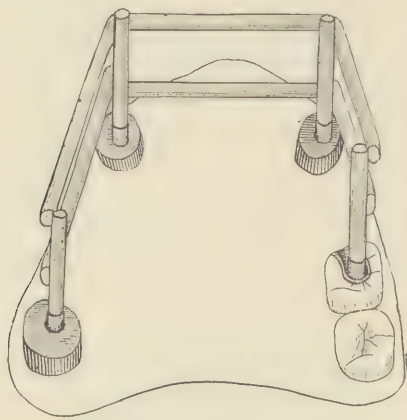


FIG. 839.

(Fig. 839). Next fit the tubes mounted on the staple in the root-canals in the mouth, then remove. Remove collars and inlay matrix from the model and adjust them in the mouth. Trim collars and add floors.

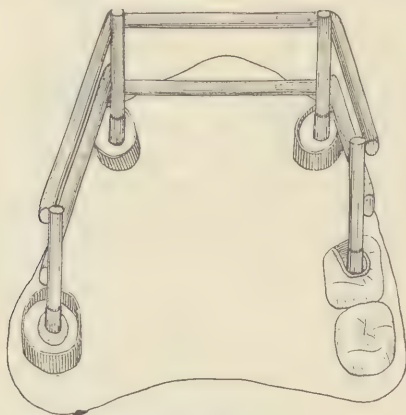


FIG. 840.

Make holes in floors and insert the tubes mounted on the staple, through the floors and matrix (Fig. 840). Press wax in the openings around the tubes in floors and inlay matrix, place plaster around on each and remove all together with the staple.

Remove separately from the staple all the tubes with the caps, invest them separately, remove plaster on floor and tube and solder

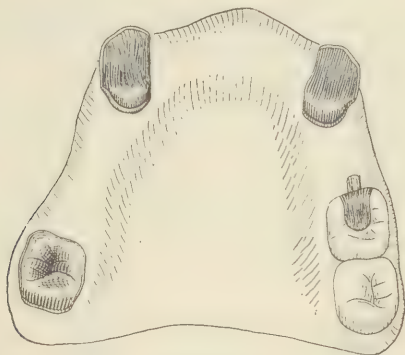


FIG. 841.



FIG. 842.

the tubes to the floor. Remove the protruding portions of all the tubes. Outer caps with split posts are next made for the cuspids, the

telescoping cap with split post for the right molar and the male inlay with split post for the left molar.

An ensemble of all the parts is then made in the mouth, an impression and "bite" taken, and models made mounted on an articulator. The porcelain facings of the cuspids and the occlusal cusp of the right molar are then added (Fig. 841).

In the construction of the bridge, the second bicuspid pontic on the left side is securely united to the male section of the removable split-post inlay attachment. In a case where the conditions do not permit the inlay attachment to be removed with the bridge in the construction, it is united after the remainder of the bridge is formed, in a separate fitting and soldering operation. Fig. 842 shows the completed bridge.

Diversity of Constructive Details.—In paralleling the canals for the tubes, place the tubes on brass rods or the steel mandrels on which they were formed, and with them parallel the tubes in the mouth, guided only by the eye. Each mandrel tube and cap is then covered with plaster, removed, the mandrels removed from the tubes, each tube and cap separately invested, and the tube soldered to the cap. This method practiced by an expert simplifies the work. It is best not applied to over two abutments.

Detached-post crowns, or replaceable porcelain facings may be used instead of the ordinary two-pin porcelain facings, as described in fixed bridge-work.

Paralleling Instruments

The effective manner a staple parallels attachments, especially when more than two are used and the fact that it can be applied in the mouth or on the model, more than compensates for the time and labor consumed in its formation. Several mechanical paralleling devices are in use to take the place of a staple. Some of these devices involve the principle of the sliding gage and others that of a compass with paralleled right-angle attachments on the branches. The sliding gage principle, as utilized by instruments consisting of a gage arm extending from a horizontally placed movable base, is a style much favored at present.

The Robinson Paralleling Instrument

This instrument is shown in Fig. 843. It is simple in construction and in method of application. A is the base, from which extends the upright rod B. From the sliding socket C is extended the adjustable rod D at a right angle to the rod B, and parallel to the bottom of the

base A. The adjustable rod D carries on its point the socket E, in which is inserted the sliding rod F, which moves up and down in the socket E parallel to the rod B.

The instrument is operated on a perfectly flat smooth surface such as a piece of glass. The base of the model on which attachments or sides of crowns of teeth are to be outlined for clasps, has first to be adjusted on the surface of the glass in a position that will place a perpendicular line of the attachments or teeth to be marked parallel with the upright rod B. This is accomplished either by trimming the base of the model, or by the addition of soft plaster to the base.

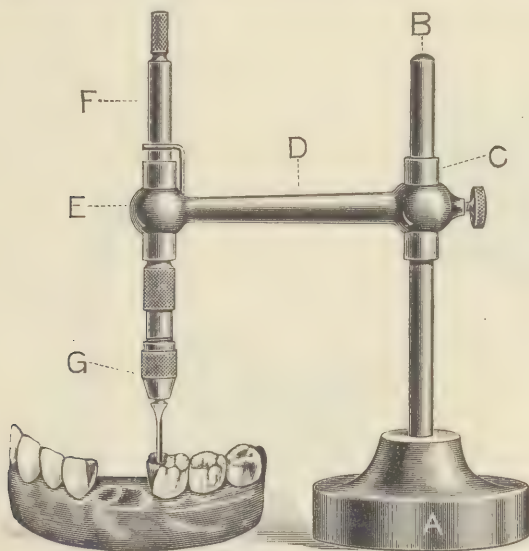


FIG. 843.

The attachments are mounted on mandrels and each fastened one at a time in the socket G of the upright rod F and placed in their respective positions in inlay or crown, the paralleling instrument being moved around the model on the surface of the glass for the purpose.

Cohen Parallelogage

This paralleling device differs from others here described in that the model is set on a defined movable adjustable base that permits locating and paralleling the attachments in any required position. Fig. 844 illustrates this instrument.

AB is a support termed the table on which a model has been mounted with plaster ready to be placed on the parallelogage.

The receptacle C of the parallelogage receives the circular leg of the table, permitting the table to revolve.

The receptacle is connected to the revolving base H by a hinge-joint D. This combination with that of the receptacle permits the model to be revolved and tilted to any required angular position and then fastened by the screws E and F.

G is a horizontal rail on which the revolving base rests and slides, enabling the model to be moved laterally. K is a screw to fasten the revolving base in position on the rail and J is the screw to secure the

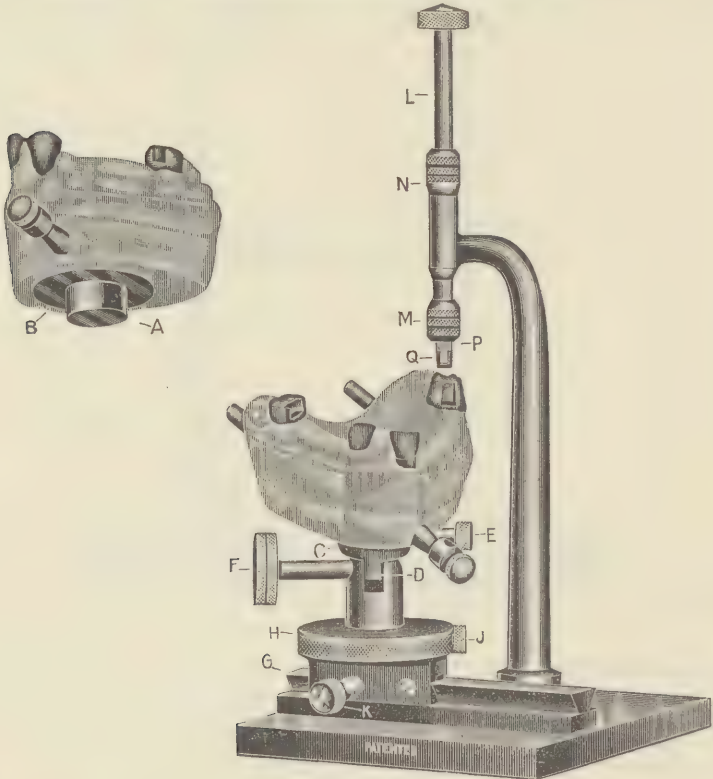


FIG. 844.

revolving base against rotation. This combination of these several parts and use of screws allows the model to be placed and retained in any required position for paralleling two or more attachments thereon.

L is a vertically supported rod carrying on its lower end a chuck M to receive and fasten the mandrel P. The rod L allows the box Q on the mandrel P, vertical and rotary movements. N is a screw to fasten the rod L.

In practical operation of the instrument, when the position of the model for positioning the attachments has been determined, the clamping screws E and F are to be tightened and not thereafter loosened. The model is then left free to be rotated on the revolving base H, or moved laterally on the rail G until the location for the box Q is determined.

The Chayes Parallelometer.—This instrument and its use in connection with the Chayes attachments is described in Part V, Chapter VI. The ordinary mandrels may be used with this instrument to parallel removable bridge tubes, in the same manner as with the set that comes with the instrument.

CHAPTER III

REMOVABLE SADDLE BRIDGE-WORK

A dental saddle bridge scientifically defined is a combination of a truss and pontoon bridge. The supporting crowns act as the truss abutments—substructure—and the saddle the superstructure—bearing on the ridge as the pontoon.

A saddle should fully cover the area of the absorption of the alveolar ridge caused by the loss of the teeth to be replaced, and when permissible should extend a little beyond it. In removable bridge-work a saddle is not open to the same objections as in the fixed form. The use of saddles, in the construction of removable bridge-work, especially on the mandible, is gradually becoming the preferred method.

A saddle of the proper size will materially aid the abutments in sustaining a bridge by relieving the direct and lateral stress on the abutments. It also permits restoration of the contour of the parts absorbed, thus avoiding spaces under the artificial teeth.

Construction of Saddles.—In the typical case, Fig. 831, the application of a saddle under the bicuspids will be described.

The abutment crowns are placed in position and an impression taken of the portion of the alveolar ridge that is to be occupied by the saddle.

In the construction of saddle bridge-work, interchangeable facings or detached-post crowns, are preferably used on the porcelain-faced abutment crowns, as the porcelain can be removed during soldering operations. In the typical case in hand, an interchangeable porcelain facing will accordingly be used on the cuspid.

Methods of Taking Impressions for Saddles.—A plaster impression is the most reliable and most used. The following method is one that will depress the soft parts of the membrane of the alveolar ridge, make an allowance for the movement of the muscles of the cheek and in the case of a lower impression, the muscles of the tongue. A wax or compound impression of the part to be covered by the saddle is first taken in a small impression cup, and a plaster model run. The part to be occupied by the saddle is marked on the model, as shown at A, Fig. 845, and the surface of the model given a coat of sandarac varnish. When

the varnish has dried, the surface is wet with water, and upon it is shaped a piece of softened compound about the size of the intended saddle, and extended up on the mesial side of the molar crown and the distal side of the cuspid. The compound is then chilled, removed from the model and trimmed, guided by readjustment on the model, so that it will only cover the portion outlined for the saddle, less about one-eighth of an inch at the buccal side, as shown at B. The object of this reduction of the area for the saddle is to give the muscles that much more room for movement. The impression compound is intended as a medium to carry and compress the plaster on the central portion of the ridge, and allow it to press out at the side and take the form of that part in a manner that will leave more room for movement of the muscles.

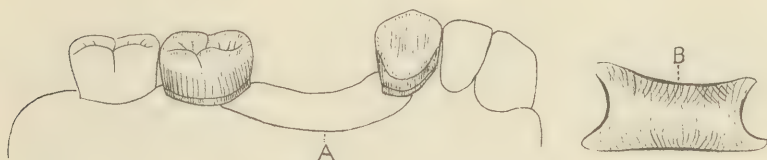


FIG. 845.

The compound having been trimmed as described, the surface of the impression is slightly serrated. The plaster is then mixed to the consistence of a thick cream, the compound dipped in water, the surplus water shaken off, and the surface of the compound evenly covered with the plaster inserted and pressed to position in the mouth, and the patient instructed to instantly contract the muscles of the cheek and so hold them until the plaster sets. In a lower impression the patient should raise the tongue and so hold it. This gives an impression of the contracted form of the tissue and muscles, that allows space for their movement, which aids in avoiding irritation for want of room when the saddle is worn, an important matter from a practical standpoint.

The impression when removed is varnished and oiled and a plaster model run and the exact size of the saddle is marked on the model. On the palatal side the space marked should entirely cover the area of absorption of the alveolar process. The surface of the plaster model should be scraped at the edge of the space at the palatal side about one-thirty-second of an inch in depth to countersink the edge of the saddle and cause it to slightly indent the membrane.

The saddle is made with a turn-over rounded edge. For this purpose a wax ridge one-sixteenth of an inch high, is built around on the model at the line marked as the size for the saddle, as illustrated in

Fig. 846 and in section in Fig. 847. To lessen the pressure of the saddle on the gingival margins of the membrane at the abutments, that part is marked on the model, and narrow layers of thick tin foil added until a thickness represented by about gage No. 26 is obtained, as indicated at TF, Fig. 846.

The same result may also be effected by scraping the same area in the impression around the abutments before running the plaster model.



FIG. 846.

A zinc die and lead counter-die are made in the usual manner. To simplify the making of the mold for the casting, trim the plaster model and cut off the teeth to the line to which the plate will extend.

The saddle is made of platinized gold, gage No. 28 to 29, or platinum, gage No. 32 to 33. Platinum is the metal preferred for the health of the membranes, but as it has to be reinforced with 22-carat gold, and the difference of the expansion and contraction of the two metals when heated, is such as to slightly warp the saddle, a preference is now being given to platinized gold.



FIG. 847.



FIG. 848.

The metal plate for the saddle should be cut enough larger to allow for the turned-up rim and provide a slight surplus for trimming. The plate is swaged to the form of the die in the usual manner and the turned-up edge is trimmed evenly all around. The under side of the saddle is painted with rouge, and coin or 22-carat gold is flowed evenly into the groove of the turned-up edge and on the adjacent surface of the saddle, to reinforce the saddle and permit a rounded form to be given the edge later on. When platinum is used for the saddle, a film of pure gold should first be flowed over its surface before the coin or 22-carat gold is applied. The surface of the metal is smoothed with a carborundum wheel and the edge rounded, as shown in section in Fig. 848.

The saddle is next cleaned in acid and again swaged, to correct any warping occasioned by the gold that was flowed over its surface.

Cast Saddle.—When a cast saddle is used, a correspondingly shaped ridge of wax is placed around the margins of the wax model to secure an oval edge. In both swaged and cast saddles, the metal should be extended around and slightly up on the sides of the abutments approximal to the saddle to aid in retaining it in correct position on the ridge when fitted in the mouth and to facilitate uniting it with solder to the abutments.



FIG. 849.

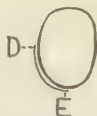


FIG. 850.

When the saddle is formed, it is fitted in the mouth and note is taken whether the flanges of the metal extending up on the abutments press on them in such manner as to interfere in the slightest degree with the saddle freely taking its position on the ridge.

The edge of the saddle when fitted against the molar crown should extend from the mesial side slightly around on the buccal and lingual sides, as indicated at A and B, Fig. 849, in all about one-third the circumference of the cervix, and in the case of the cuspid, from the labio-distal edge of the partial collar, as indicated at D, Fig. 850, and well around on the lingual side, to the point marked E. Fig. 851 shows the fitted saddle in position.

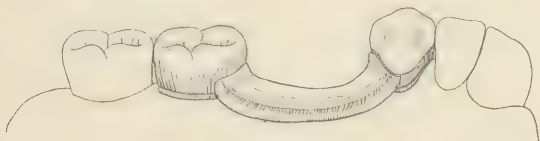


FIG. 851.

In all forms of removable saddle or plate bridge-work, when the crowns and attachments are in position in the mouth, the plate constituting the saddle should not merely rest on but *should press* on the intervening alveolar border, to better afford support. Such construction is obtained by applying a suitable amount of pressure on the saddle with the abutment crowns in position in the mouth when taking an impression.

In taking the impression in the case shown in Fig. 851, pressure is exerted on the saddle with the finger, and plaster applied on and around the abutments, saddle and adjacent parts. The finger is held steadily until the plaster sets (Fig. 852).

Another method is to exert pressure on the saddle with an instrument, and apply the plaster in an impression tray with an opening in

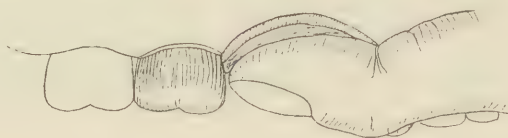


FIG. 852.

the bottom to accommodate the instrument, as shown in Fig. 853. A little compound previously melted on the center of the surface of the saddle will prevent the point of the instrument from slipping (Fig. 854).

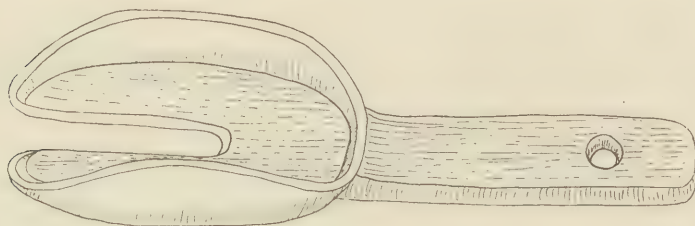


FIG. 853.

The model made will show the abutments and saddle in position as in the mouth.

The ends of the bridge are next waxed to the outer crowns. To prevent the slightest displacement in removal or investing, a piece of iron

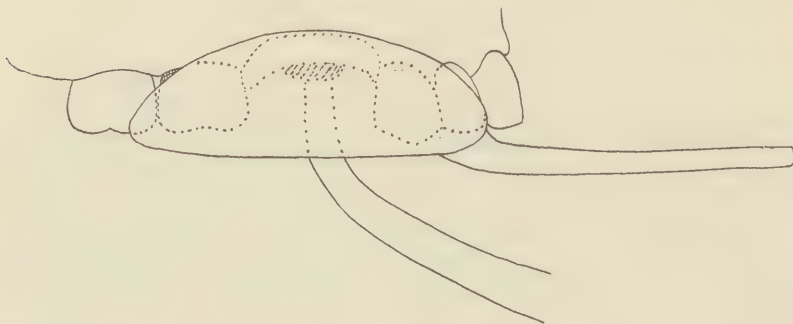


FIG. 854.

wire, about gage No. 15, is bent to rest on the surface of the saddle with the ends extended on the lingual and occlusal surface of the outer or removable section of the molars and cuspid crowns, as shown in Fig.

855. The wire is waxed in position to the saddle and to the removable section of the crowns only, with hard adhesive wax. The saddle and crowns are removed from the model and the inner caps are removed from the outer crowns. When the crowns waxed in position with wax cement cannot be removed without displacement, plaster should be applied. This is often necessary when a model is made without provision for the removal of the inner caps from the model. The outer crowns with the saddle are invested. The investment should extend up over the sides of the saddle to retain it in position for the



FIG. 855.

soldering. If a replaceable porcelain facing or detached-post crown has been used, it is removed from the outer cap and the vacancy filled with additional investing material. The invested case will then appear as illustrated in Fig. 856. The soldering is preferably done with 21-carat solder. The solder should be first drawn into the seams and the parts then united by the addition of sufficient solder. It should be allowed to cool slowly—*never immerse in water while hot*—and then cleaned in acid and adjusted on the model with the inner caps in place.

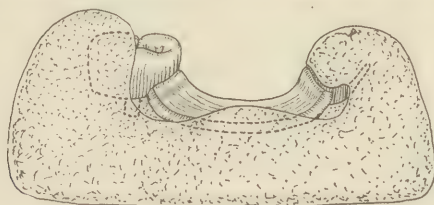


FIG. 856.

If any slight warping has occurred through contraction of the solder, it can generally be remedied by holding the crowns firmly in position on the model and then pressing on the saddle. If the contraction is considerable, the end at which it occurred must be detached from the cap, the warping corrected and the saddle and caps reinvested, and the warped end again soldered. Contraction can usually be controlled by investing so as to expose and solder only one end of a saddle at a time, readjusting on the model and then again investing and soldering the other end.

The Articulation.—An articulation is next taken, preferably with plaster, for accuracy. The plaster should be applied so as to include one or two of the adjoining teeth, as a new model must also be run, for the reason that the plaster articulation will seldom allow the bridge to fit on the model previously used.

The plaster is mixed moderately thick and placed over the saddle, also the abutment crowns and one or two of the adjoining teeth, and the patient directed to occlude the teeth. It is well to carefully examine and see that the teeth have been properly occluded. When the impression is removed, the model and articulation are made in the usual manner, preferably in artificial stone.

The Pontics or Bridge Teeth.—In removable all-gold saddle bridge-work, detached-post crowns or English tube teeth are most commonly used on the saddle, as they are light in weight, replaceable in case of fracture, and more artistic in appearance than porcelain facings with gold backings. They are set in gold sockets soldered to the saddle.



FIG. 857.



FIG. 858.



FIG. 859.

The porcelain crowns selected are ground to articulate and their bases to conform to the shape of the saddle, leaving sufficient intervening space for the gold bases or sockets. They are then beveled around the edge of the cervical section, as shown in Fig. 857, to make room for the rim of the gold base. The gold bases are formed by casting, or by swaging pure gold gage No. 35 to 36 (see pages 213 to 215). The rim of each socket should be extended up on the porcelain sufficiently to allow for soldering and finishing.

In the formation of cast bases for porcelain teeth, an allowance should be made for the shrinkage of the metal. To this end the bases should be varnished with collodion and vaselined as described on page 215, or a piece of tin foil, about .005 to .009 of an inch in thickness should first be adapted or swaged over the base of the porcelain tooth. The thickness of the foil should be increased in proportion to the size of the base. The surface of the foil is lubricated to permit easy removal of the wax model. Wax models of the bases are best made singly, formed with a thin layer of wax extending down on the sides of the saddle, to aid later in contouring its surface when soldered, as shown at E E in Fig. 858, which also shows the sprue wire inserted.

The post or pins are soldered in the cast or swaged bases with coin gold. The teeth are adjusted in the bases and fitted to position on the saddle. This is more easily done with cast than with swaged bases, as they fit the form of the surface of the saddle.

When the teeth and bases have been fitted on the saddle, the teeth are removed from the bases and each base is held in position on the saddle with wax and invested. Fig. 859 shows the case invested, leaving the lingual surface of the saddle and base exposed. The inside of the base into which the crowns fit is coated with rouge or antflux before investment to prevent invasion of the solder and interference with the fit of the porcelain. In the operation of soldering, the bases of the crowns are first united to the saddle by flowing under them 20-carat gold solder from one side to the other. This is assisted by the application of the large flame under the investment. Sufficient solder is then added by degrees to fill in depressions between the bases and the rounded

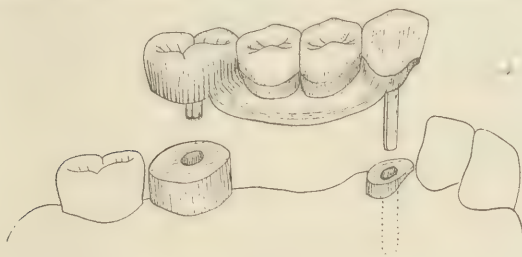


FIG. 860.



FIG. 861.

edge of the saddle so as to even its surface and admit of proper finish. To accomplish this at the buccal side, it is frequently necessary to again invest the bridge and apply solder at that part.

The teeth are then cemented with oxyphosphate in their bases and the edge of the gold burnished closely against the porcelain. When the cement has thoroughly set, all parts of the metal are finished. Any interstices that may exist between the porcelain and the gold should be filled with foil or Corona gold so as to effect continuity of structure. Fig. 860 illustrates the finished removable bridge. Fig. 861 shows the same method of investing the gold base of a cuspid detached-post crown see Fig. 398, to solder it to the floor of the outer cap when used as an abutment.

Cast Saddle and Bases.—A small cast saddle may be made to include in one casting bases for the artificial teeth by forming them on the wax model of the saddle.

Saddles could be advantageously applied to the typical case, Fig. 842, under the teeth on the right and left sides, also under the anterior

teeth. But it could not be as advantageously done under the anterior teeth as the base of each of these teeth can be made to rest and slightly press directly against the tissues, which makes an agreeable form for the patient. Fig. 862 illustrates the case with saddles under the posterior pontics. In this case the right and left saddles are made separately by swaging or casting and then applied.

In taking an impression in a case with saddles on both sides of the mouth, pressure must be applied equally to both saddles at the time



FIG. 862.

the impression is taken. To accomplish this, first take an impression in the compound with the saddles and crowns in position, chill and remove. Take saddles and crowns from the impression and replace them in the mouth. Trim the compound so that it will rest only against the saddles when inserted, as shown in section for one side in Fig. 863. The impression tray is then filled with plaster and brought to position,

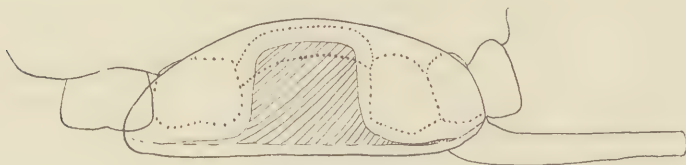


FIG. 863.

with the exertion of sufficient force on the tray to cause the compound to press the saddles firmly against the alveolar ridge.

Another method of producing pressure on a saddle when taking an impression, is to place small wooden posts between the surfaces of the occluding teeth and the saddle, of sufficient length to permit the introduction of the tray. The patient is instructed to compress the tissues

under the saddle with the occluding teeth during the setting of the plaster. An impression tray with slots on both sides that will accommodate the posts must be used.¹

Construction of Porcelain-faced Solid Gold Pontics for Saddles.

Short bicuspid and molars of this form may be constructed as follows: The porcelain facing is ground to position on the saddle and a plaster matrix is made against the labial aspect, to permit the facing to be removed and replaced in position. A wax model of the required form of the remainder of the pontic, is made in accordance with the articulation, as shown in section, Fig. 864. The porcelain facing is then removed, carbon points inserted in the pin holes and a cast of the wax section made of pure or slightly alloyed gold, the same as in the case of a "Cast Box Backing," as shown in Fig. 549. The porcelain facing is next fitted in the cast section, the pontic adjusted, the gold section waxed in position on the saddle, and the porcelain facing removed. The saddle is invested, and the base of the gold section of the pontic soldered to the saddle on both sides, and the depression between it and the rounded edge of the saddle leveled with 21-carat solder. Fig. 865



FIG. 864.



FIG. 865.

shows the case ready to receive the porcelain facings, which are next cemented in position. Any interstices are filled with foil or Corona gold and the surface of the gold smoothed and polished.

Solid Gold Tooth Pontics.—In a case requiring very short gold pontics without porcelain facings, a wax model of each tooth is made and cast. The gold tooth is then fitted on the saddle as in the previous case, invested and soldered to it, on buccal and lingual sides.

The weight of all forms of cast solid gold pontics, either with or without porcelain facings may be lessened by the removal of a portion of the interior of the wax model with a wax absorber (see Figs. 437 and 438).

Vulcanite Attachment.—In saddle and plate bridge-work the artificial teeth—pontics—can be attached to the saddle or plate with vulcanite, the use of which considerably lessens the labor of construction, and for upper cases has the advantage of lightness as compared with gold. Ordinary porcelain teeth for vulcanite, or Diatoric teeth, are mostly used. Two or three loops of wire or a narrow strip of plate

¹ Dr. Hart J. Goslee's method.

should be soldered on the saddle as an attachment (Fig. 866). When a strip of plate or a small wire is used, it is best attached before the final swaging of the saddle, to avoid warping that might occur in a subsequent soldering. Rouge or mica placed under the strip or wire between the points to be soldered, will prevent the solder from uniting the strip or wire to the saddle and allow it to be raised up subsequently when the rubber is applied, as shown in Fig. 867.

When a vulcanite attachment is used, the work should be so conducted as to secure not only an attachment, but an adhesion of the vulcanite to the gold. This can be effected by cleaning the surface of the metal that comes in contact with the rubber, then going over it lightly with a small scraper. The packing of the rubber should be done entirely by dry heat; water, steam, oil or grease being excluded from contact with the surface of the gold or rubber. During vulcanization the flask should be placed on a stand above the water in the vulcanizer. When so conducted the result will amply repay for the slight extra labor the method involves.



FIG. 866.



FIG. 867.

Extension Saddle Bridge

This form, which in principle is a cantilever, is employed to replace bicuspid and molars by the use of only an anterior abutment. The abutment should properly consist of at least two teeth to resist the leverage that will be exerted in occlusion.

Fig. 868 illustrates a removable saddle bridge to replace two lower molars. The abutment consists of a first bicuspid porcelain-faced tube and split-post collar crown, united to a second bicuspid all-gold telescope, tube and split-post crown.

Fig. 869 shows the lingual aspect of an extension bridge retained by a split bar in both of the pulpless bicuspid, and the method by which the bar to the first bicuspid is attached to the second bicuspid bar by a flange extended around the lingual side of the latter resting on a ridge. Fig. 870 shows the bridge from the buccal side in position.

An Adjustable Saddle.—The gradual settling of the saddle and the consequent stress exerted on the abutment in occlusion is an objection to extension bridge-work. Injury from this cause may be remedied by the use of a readjustable saddle. To effect such a form of construction, the artificial extension teeth are first united with gold to the abut-

ment independent of the saddle, and then attached to the saddle with gutta-percha. This permits the saddle to be easily readjusted to the alveolar ridge without changing the occlusion of the teeth.

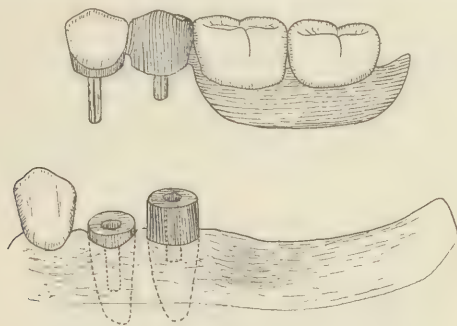


FIG. 868.

To readjust the saddle, heat and remove it and slightly increase the quantity of gutta-percha. The bridge and saddle are then heated sufficiently to soften the gutta-percha, the bridge is adjusted to position in the mouth by first using pressure with the fingers and next by the

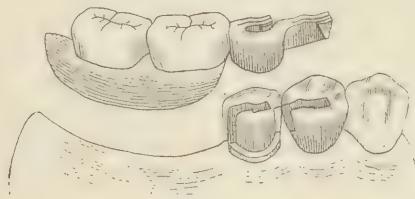


FIG. 869.

patient occluding the teeth. Remove and reheat bridge and gutta-percha and readjust until the bridge assumes its proper position. Fig. 871 outlines in section the plan of the formation of a porcelain



FIG. 870.



FIG. 871.



FIG. 872.

tooth with a gold base for such a bridge and the pin that secures it to the saddle. Fig. 872 is another form consisting of a hollow gold tooth with a loop of wire instead of a pin. This latter form is the best to use when short teeth are required.

Vulcanite Extension Saddle.—Fig. 873 outlines a bridge of this style. The pontic teeth are formed of hollow reinforced gold crowns. The gold pontics are placed in occlusion, leaving a space of about one-eighth inch between the cervices and the alveolar ridge, and in this position are securely soldered to each other and to the abutment. An impression is next taken of the alveolar ridge in correct relationship to the bridge with impression compound. This is done by placing a suitable quantity of the compound over the necks and in the hollows of the gold pontics, then adjusting and pressing the bridge to position.

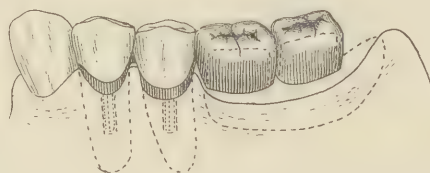


FIG. 873.

in the mouth. The bridge is removed, a plaster model made, and a vulcanite saddle formed. The base of such a saddle can be renewed at any time in exact conformation with the alveolar ridge, by removing the bridge and slightly indenting the surface of the vulcanite over the alveolar ridge, placing impression compound or wax upon it, taking an impression of the ridge, and substituting vulcanite for the compound or wax. This is a form of saddle very suitable to apply when teeth have been recently extracted and absorption of the alveolar process is still taking place.

CHAPTER IV

REMOVABLE PLATE BRIDGE-WORK AND CLASPS WITH LUGS

Removable Plate Bridge-work is practically plate-work sustained by clasps or collars with anchorage lugs, or some form of attachment that fastens or anchors on the abutment teeth, crowns or inlays. The insertion of dentures of this form of construction and which of late is

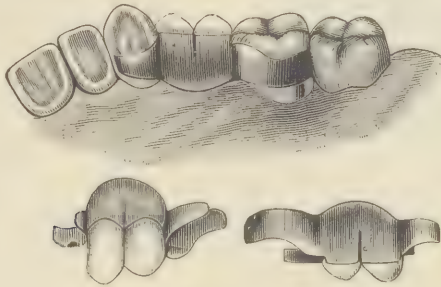


FIG. 874.

growing in favor, is not of recent conception, having been described in this treatise by the author in 1888 and by Dr. W. G. A. Bonwill in 1893.

Fig. 874 shows a plate bridge to replace two superior bicuspids supported by clasps on the cuspid and molar with lugs resting on shoulders at the points A A, Fig. 875. In this case the clasps after having been

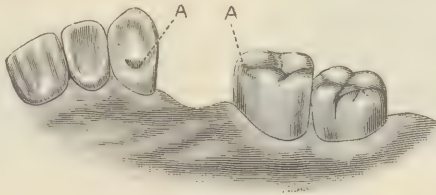


FIG. 875.

shaped and soldered to the plate were heated and their inner surfaces veneered with wax. When the veneer had cooled, a layer of soft wax was placed over the approximal and lingual surfaces of the veneer and the plate and clasps pressed to position in the mouth and removed. Platinum foil $\frac{1}{2000}$ to $\frac{1}{1000}$ was annealed and evenly placed over that part of the surface of the wax that had covered the approximal and lingual surfaces and also the edge of the occlusal surface of the molar.

The plate was inserted, pressed firmly against the tissues and the edge of the wax pressed with the finger against the foil. The plate was removed, invested and solder flowed between the clasps and foil.

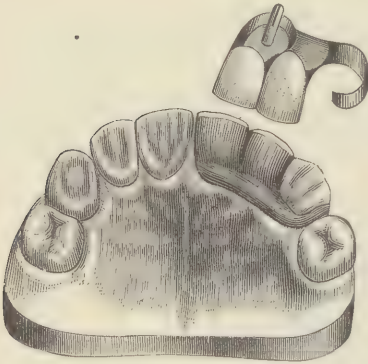


FIG. 876.

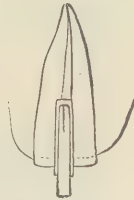


FIG. 877.—Shows in section central incisor root with tube and split post in canal.

Surplus foil and gold were removed, leaving only enough at the edges of the clasps on the edge of the occlusal surface of the molar and lingual surface of the cuspid for support.

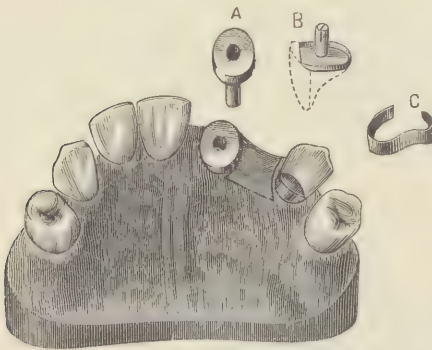


FIG. 878.—A, Cap and tube for central; B, FIG. 879.—Shows cuspid with gold half-collar central crown with split post; C, filling. A, Notch for lug clasp for cuspid.



Fig. 876 shows a plate bridge to replace a left superior lateral. Figs. 877, 878 and 879 illustrate and explain the form of the construction.¹

¹ The case shown in Figs. 874 and 875 occurred in the practice of the author; the piece inserted by him in 1886. This case and those illustrated in Figs. 876 and 878 were described in the first edition of this treatise in 1888.

Figs. 88o and 881 show Dr. Bonwill's method of replacing a bicuspid and a molar.¹

Merits.—In artificial restorative methods by removable plate bridge-work, mutilation of the supporting teeth or removal of pulps is seldom necessitated. For these reasons replacement of absent teeth may often be effected, where it would not be considered advisable by other methods or be sanctioned by the patient.



FIG. 88o.



FIG. 881.

Limitations.—The use of removable plate bridges is best confined to cases of replacement of posterior teeth where the alveolar ridge is absorbed: also where the character of the abutment teeth for stability, health or other conditions suggests the method. It is a method seldom used for incisors or cuspids except when such teeth can be placed on the same plate that is being used to replace posterior ones.

Clasps with Lugs.—In removable plate bridge-work, clasps with lugs are used on either natural or artificial crowns. In natural teeth the lug is usually set in an inlay or filling, and in artificial crowns in a socket made in the crown. A lug aids in retaining a clasp in position to better resist lateral strain, enables it to bear pressure exerted on the denture in occlusion, prevents impingement on the gingival margin, and when applied to a natural crown lessens liability to abrasion of the enamel by steadying the clasp. The use of this form of attachment is increasing in favor, as its application often avoids the alternative of a capping or crowning operation.

¹ Cases described by Dr. W. G. A. Bonwill in the *International Dental Journal* in 1893.

The clasps are made of iridio-platinum gold clasp gold. The portion of the clasp requiring resiliency should be left entirely free and not reinforced with solder. In the formation and use of clasps, the following points are to be considered:

1. Flat plate clasps are most suitable when the natural crowns are nearly straight-sided and for clasping similarly shaped artificial crowns. Round and half-round wire clasps are best applied to natural crowns with contour and to short crowns.

2. A clasp that encircles four angles of a crown, obtains a better hold than if it encircles only three, and a clasp to reliably grasp must encircle at least three angles. When less in length a clasp will only press against the tooth or crown unless it is retained in position by a lug.

3. For strength the widest or heaviest part of the clasp should be nearest its union with the denture.

4. The strength and rigidity of a clasp lessens as it extends from where it is united with the denture. Consequently a clasp should be uniform in width and thickness, and if it tapers, should do so only slightly towards the ends or points.

5. A clasp should extend over the surface of the sides of a natural or artificial crown, not nearer than one-sixteenth to one-eighth of an inch from the gingival margin, to avoid irritation of that membrane. The edge of a clasp must entirely clear the occlusion.

Preparation for Clasp Attachment.—Clasps should be placed and shaped to move on and off as nearly as possible parallel with each other and any other attachments present. The adaptation of a clasp as close as is practical to the contour of a natural tooth when adjusted is all that is expected or required. Adjustment and adaptation to some teeth is much facilitated by slightly trimming and then polishing one or more projecting points of the enamel. This is especially the case when teeth tip out of line. A plaster study-model of the case will guide this part of the work. In the case of artificial crowns, flat plate clasps should be used, shaped as straight and close as possible to the sides.

As a pattern for a plate clasp, shape on the model or die of the tooth a piece of thin annealed sheet copper or tin a shade wider and longer than required. Use gold clasp plate not less than gage No. 24, round wire Nos. 12 to 18 and half-round wire, gage No. 12, 13, or 14; the larger the tooth, the greater the thickness of wire, to proportionately insure strength and permit any necessary trimming. The labial section of a plate clasp on an inferior cuspid ought to be made wide, and

on a superior cuspid as wide as it properly can be without causing too much exposure of the metal.

Shaping Clasps.—A clasp after being bent with suitable pliers is most easily shaped to the form of a natural crown by the aid of a die. The best method is to take a sectional impression of the tooth and make an amalgam die. From the amalgam die take an impression in a tube with moldine and run a fusible metal die. Use the fusible die for the preliminary shaping and the amalgam for the final. In the case of a gold crown, fill the interior with fusible metal, and use the crown as a die. In the shaping and trimming of clasps, frequent transferring from the die to the model and annealing are necessary. In the construction of the round or half-round wire clasp, it should be brought just over the curve of contour of the tooth so that it springs to position.

Swaged Clasp and Lug

A cuspid being a difficult form to shape rolled gold clasp plate to, will be used as a typical case to illustrate the method. An impression of the crown is taken in plaster in a sectional impression cup (Roach's). On removal the impression is clamped together with the handle. A groove that encircles the cervix of the impression of the crown is made in the plaster, as indicated in section in Fig. 882 as indicated

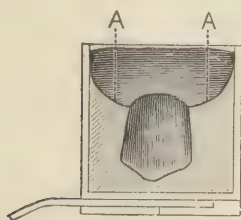


FIG. 882.

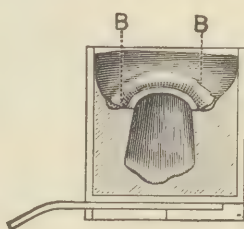


FIG. 883.

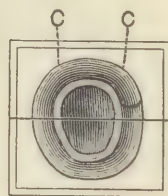


FIG. 884.

at the points A A. Fig. 883 shows the formed groove at B B, and Fig. 884 at C C. This groove creates on the die when cast, a ridge around the form of the crown with an indentation at the cervix as shown in Fig. 885 at D D. This indentation is for the cervical edge of the clasp to rest in and retain it in position when swaged.

The Die.—The die is made of fusible metal by the pressure method. By this method several dies can be immediately cast from the same impression. These dies will give all the accuracy of detail obtained in the amalgam die without waiting for the setting of the amalgam.

Casting Fusible Metal under Pressure.—Hold the impression cup by the handle. Pour enough of the molten fusible metal into the impression of the crown to slightly more than fill it, then instantly

press the metal down into the mould with a wad on the point of a blunt instrument, such as is shown in Fig. 886. The wad is made of a ball of cotton, covered with a piece of thick muslin, the ends of the muslin tied with a cord around the instrument. The wad is held against the fusible metal for a few seconds until the metal around the edges shows it is congealed. The wad is then removed and more metal—melted quite hot—is added without pressure to form the base of the die.

The pressure on the metal first poured into the impression injects it into every portion and crevice of the impression. When cool the impression is opened and the die removed. One or more additional dies can then be cast in the same manner. As the fusible metal under this pressure method usually shows the line of the seam in the impression, the die requires to be slightly trimmed to remove it.



FIG. 885.

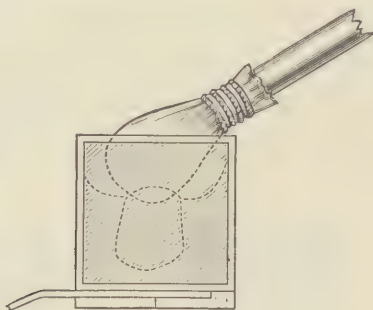


FIG. 886.

Forming the Clasp and Lug.—A pattern of the gold clasp is made of thin copper plate and a piece of No. 24-gage clasp gold plate out of a corresponding size. The plate is annealed, then shaped with pliers and trimmed to fit the form of the die as accurately as can be done in this manner.

The clasp is next annealed, placed on the die and both clasp and die covered with heavy pattern tin of about $\frac{3}{1000}$ or 40 gage in thickness and the ends brought under or over the base and twisted together. Another larger piece of the pattern tin is next placed over the first one. The die is then placed in a swager covered with moldine and swaged. Light blows are to be first given with a large heavy hammer and the blows gradually increased to full force. As particles of the moldine are liable to fly out from around the seams of the swager and injure either the hand, face or eyes, owing to the great force applied, *the entire swager should be covered with a cloth during the swaging.*

The die is removed, the covering of tin scraped off, which will be found closely adhering to both clasp and die, the clasp annealed and the edges trimmed as for use in the mouth. Any part of the clasp that is not as yet closely adapted to the die, is tapped with a riveting hammer. Clasp and die are again covered with the pattern tin and swaged as before. This process is continued until the clasp fits the die perfectly *at every point*. For the final swaging the clasp is placed on a new die and the adaptation in detail completed by a final swaging.

Bicuspid and Molars.—For bicuspid and molars, as the cervical edge of a clasp is only extended over the bulge of the contour, a die with the cervical groove to retain the clasp in position as it is swaged, is necessary. This ridge and groove may be formed by scraping away the cervical edge of the impression of the tooth to the line the clasp is to extend before casting the die.

For securing greater accuracy of the cervical line of the clasp, a sectional plaster impression of the tooth is first taken and a fusible metal die run. The cervical line of the clasp is marked on the die with ink and a wax ridge with a groove formed to this line. A sectional impression of the die in plaster is next taken and a die run. This die will show the necessary ridge and groove in proper position.

The method here outlined for bicuspid and molar dies may also be applied to other teeth that suggest it.

In swaging clasps for bicuspid and molars the clasp gold may be extended entirely around the die and the ends united either by sweating or with a particle of solder (Fig. 887). The edge of the clasp should be tapered and tapped over the occlusal edge and then swaged in the swager. When swaging and finishing are completed the portion necessary to properly separate the soldered ends of the clasp is to be removed. For large molars the thickness of the plate may be increased to No. 23 gage.

First tapping the edge of a clasp and then swaging over the lingual side of a cuspid or the edge of the occlusal surface of a posterior tooth or crown so as form a ledge, is usually all that is required to retain the clasp in position. In cases of bicuspid and molars when this ledge is not considered sufficient, the clasp can be made with a lug formed from a projecting flange of the clasp, bent and then swaged down on the occlusal surface. A soldered lug, which is preferable, can be added as follows: Adapt on the die a piece of $\frac{1}{1000}$ platinum foil, in size slightly larger than is required for the lug. The edge of the foil should fit just under the edge of the clasp, as shown in Fig. 887. Adjust the clasp in position, cover and press over the platinum foil a piece of adhesive wax. With a heated spatula melt the wax against the edge of the

clasp adjacent to the foil. The wax should be extended over the surface of the foil only slightly beyond the space required for the lug, as shown by the dotted line at L. This leaves an exposed edge of the foil, which is to be covered with the investment material to retain the foil in position during the soldering. Remove clasp and foil, invest and flow hard solder between clasp and platinum and reinforce that portion of the foil which is to constitute the lug. Remove clasp and lug from the investment, trim off the surplus edge of the lug to the desired size and place clasps with lug on the die and swage to insure accuracy of adaptation.

The completed clasp is shown in Figs. 888 and 889 with the necessary portion removed, where the ends were united.

This method produces a clasp and lug attachment that will meet the cast clasp and lug in efficiency and surpass it in strength, resiliency



FIG. 887.



FIG. 888.



FIG. 889.

and reliability. Half-round and round clasp wire can be adapted by this swaging method.

Cast Clasps.—Cast clasps are used to some extent in preference to shaping plate or wire to the form of the tooth. The lack of resiliency



FIG. 890.



FIG. 891.

and the close fit of a cast clasp will not permit it to be adjusted on a crown with sharp points of contour. Its use must therefore be confined to artificial crowns, or to natural crowns whose contour is or can be made favorable to its application. Molars and bicuspsids require little or no reduction of contour, while the form of cuspsids usually necessitates considerable shaping. The cuspid illustrated at A in Fig. 890 will be used as a typical case. The distal side requires to be shaped to the form shown at B, and the surface of the enamel polished. A sectional impression is taken with plaster, and a model made of inlay investing

material. The model must have a smooth surface devoid of minute air bubbles or other imperfections to insure a smooth casting and be hard enough to withstand mutilation during construction and sufficiently resistant to heat to maintain its form in the process of casting. A single coat of very thin sandarac varnish will assist this. On this model a wax pattern of the clasp is formed, Fig. 891. This is best done by first veneering the surface of the model with melted wax, using a hot

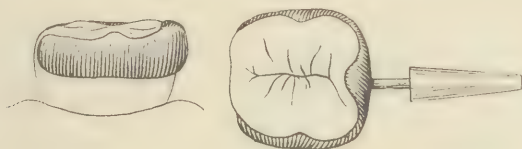


FIG. 892

spatula, then shaping inlay wax over the veneer to the required form for the clasp and lug. The surface of the model must be perfectly dry to secure adhesion of the wax. A sprue wire 15 gage is inserted in the heaviest part of the wax, and both wax pattern and the model invested in a casting flask and the clasp cast. In the case of a cuspid or incisor, a small portion of the gold placed over the surface of the contour on the lingual side will act as a lug. Fig. 892 illustrates an inferior right second molar with a wax model of a clasp, and a sprue inserted ready to invest.



FIG. 893.



FIG. 894.



FIG. 895.

Clasps and Lugs.—Cuspids are not so well suited for clasp and lug attachments as bicuspid and molars. In a cuspid with a vital pulp, a gold filling anchored with undercuts can usually be more reliably inserted to support a lug than an inlay (Fig. 893). If the tooth is pulpless, a lug with a lock pin is the preferable form to apply with the clasp (Fig. 894).

A small occlusal lug without the use of an inlay may be applied to a clasp to rest on the enamel of a tooth when no occluding tooth is present, as shown in Fig. 895. A piece of as heavy half-round clasp wire as the

case will permit is best used to form the lug. The sides and end of the lug should be closely fitted and tapered off to the surface of the tooth.

Formation of Inlay Lugs.—Inlay lugs are made by casting or by the use of a matrix. For a cast lug a wax model or matrix of the form of the lug is made in accordance with the occlusion. Applied to a flat clasp the lug is made to fit against the inner side of the clasp (Fig. 896). For a half-round wire clasp, the lug is formed to extend over the wire clasp so that the lug can be securely united, as shown in Fig. 897.

A cast lug when applied to a rolled or drawn gold clasp is cast separately, then soldered to the clasp. In the use of a matrix lug, the matrix is formed, the clasp adjusted, the matrix filled with wax and



FIG. 896.



FIG. 897.

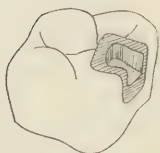


FIG. 898.



FIG. 899.



FIG. 900.



FIG. 901.

attached to the clasp. Clasp and matrix are removed and invested. The wax is removed from the matrix with boiling water, the matrix packed with Corona gold to prevent contraction of the foil, and the matrix is filled with solder and attached to the clasp. A small lug to rest in a correspondingly small slot in a gold filling should be made by the matrix method, using $\frac{1}{2000}$ platinum foil for the matrix.

Lugs for Natural Crowns.—Lugs to clasps that only rest on the teeth clasped are to be extended but a short distance on their surface (Fig. 895). The slot for the lug in an inlay or filling should be given a slight retaining oval form, as shown in Fig. 898. A lug in a gold cap crown is inserted in a slot or box (Fig. 899). It can be made by removing the required portion of the occlusal surface and approximal side of the

crown before the cusps are reinforced, then inserting the box and soldering it in position from the inside, and at the same time reinforcing the cusps. (See Figs. 581 and 584.)

Another method, when a cast gold occlusal cusp-cap is used, is to solder a gold floor on the occlusal edge of the collar, and cast an occlusal cusp-cap with a slot (Fig. 900), and solder the cusp-cap to the floor, or shape a slot in the wax model of the cusp-cap of a suitable form to accommodate the lug.

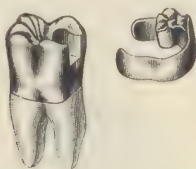


FIG. 902.



FIG. 903.

In case of a porcelain-faced gold bicuspid crown, the slot for the lug is made as follows: A vertical hole is first drilled in the finished crown to within a short distance of the floor of the root-cap, when two cuts are made with a fine saw on the side, the gold gradually removed, and the cavity shaped with small stones and burs. If exposure of the clasp on the buccal side is objectionable, form a narrower and deeper slot, of retaining form, from the occlusal surface toward the floor and extend the clasp only on an approximal and a lingual side. So placed, it will furnish a fairly reliable attachment (see Fig. 901, viewed from

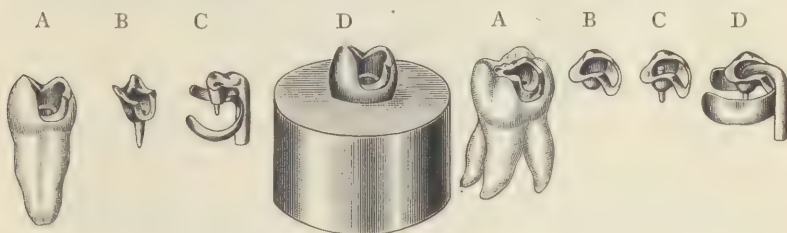


FIG. 904.

FIG. 905.

the occlusal surface). The use of such a lug and clasp on a natural crown is not practicable, unless the tooth is pulpless, so as to admit of the insertion of a securely anchored inlay which will permit a small pin in the lug.

Fig. 902¹ illustrates a gold crown with an oval-shaped lug rest cavity, and a cast lug united to a flat gold clasp.

¹ Figs. 902 to 910 are illustrations from an article by Dr. F. R. Getz, in the *Dental Cosmos*, 1916.

Fig. 903 shows a gold porcelain-faced bicuspid crown, in which is cut a narrow deep cavity for the lug: to further elucidate the method two friction lugs are also shown, one united to a flat, and the other to a half-round clasp.

Fig. 904 is a bicuspid, A, with a cast inlay, B, wire clasp with lock-pin lug, C, and a die in which the inlay was made and the matrix for the lug swaged, D.

Fig. 905 is an inlay in a molar, A, plain matrix, B, pin matrix, C, and parts assembled to form the lock-pin lug, D.

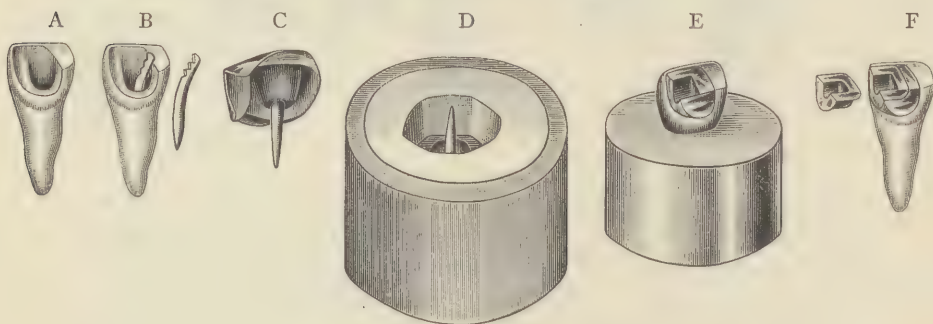


FIG. 906.

Fig. 906 illustrates the construction of a lock pin in a central used as a supporting attachment; A and B show the cavity prepared for the cast inlay with pin; C, compound impression with a steel pin embedded; D, same in flask ready to pack an amalgam die; E, die completed; F, matrix for lug and same adjusted in inlay.

Construction of a Plate Bridge

The plate used is made either by swaging or casting, preferably by swaging for large plates and by casting for small ones. The swaged plate is formed of 18- to 20-carat gold, gage No. 26, reinforced across the connecting sections. The plate is cut a trifle larger in size than is required. The cross sections are reinforced by the addition of successive narrow layers of plate about gage 32 to 34 swaged one at a time, and united with the least possible quantity of solder. The swaged plate is fitted in the mouth, and to the abutment attachments.

Uniting Attachments to Plate.—A small plate with two attachments may often be reinforced with a piece of iron wire (see page 432), cemented to them separately or together with wax, pressure exerted on the plate, the wax chilled, plate and attachment or attachments removed, invested and united with solder. In this method it is preferable to first unite the most difficult attachment to remove.

The method generally practiced is to place each attachment in position, exert pressure on the plate (see pages 429-430), take a plaster impression and remove plate and attachments in position. Fill impression with investing material, remove plaster impression, add more investing material and solder attachments to plate.

When clasp lug attachments are the form to be used, plate bridges can be constructed by forming the plate first, taking a plaster impression with pressure on the plate, filling the impression of the teeth with amalgam and the remainder of the impression with plaster or artificial stone. Clasps with lugs are then made on the amalgam models of the abutment teeth, plate and clasps cemented together, removed and united to the plate.



FIG. 907.



FIG. 908.

Before investing attachments and plate see that the attachments touch or nearly touch the plate; if they do not, add an extension by separately investing and soldering.

The plate and attachments are adjusted in the mouth, any interference with the occlusion corrected, and a "bite" taken with plaster or compound. The case is then finished, using porcelain teeth attached either with gold or vulcanite, as in saddle bridge-work. When the plate extends on both sides of the mouth, vulcanite is preferably used for lightness and to avoid risk of warping.

Figs. 907 and 908 show the replacement of a lower molar with half-round wire and lug attachments.

Figs. 909 and 910 show a removable extension plate bridge. It consists of a gold crown with porcelain facing on the right cuspid, all-gold crowns on the adjoining bicuspids, and a gold crown on the left bicuspid. The denture is made of a swaged plate with reinforced palatal bar and vulcanite attachment for the porcelain teeth. The lugs are oval-shaped and are connected by bars.¹

The right and left sections of lower dentures can be connected by a narrow reinforced strip of plate or a bar. Made in either form, a slight

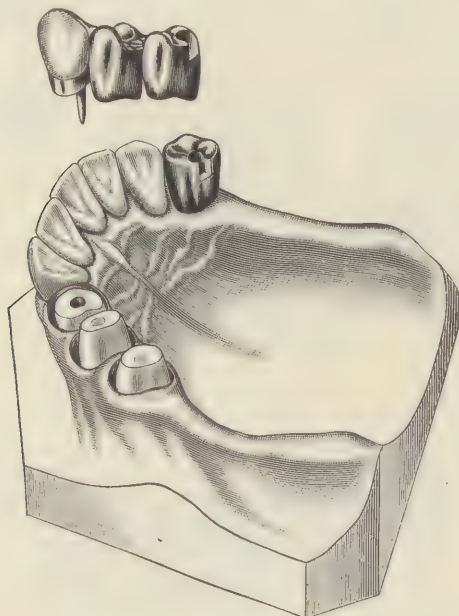


FIG. 909.

space should be left between the strip or bar and the surface of the model, so that pressure will not be brought to bear upon the tissue under it. This is definitely and uniformly accomplished by placing on this part of the plaster model successive layers of pattern tin to form a thickness of about gage No. 22 to 24 before making the mold for casting the die (Fig. 911). When a connecting strip of the plate is used instead of a bar in a lower case, such as is described, it should be reinforced by at least three additional strips of clasp gold, gages Nos. 32 to 34, each strip being cut a little narrower than the preceding one as they are swaged (Fig. 912). Each strip should first be caught at the ends with

¹ Case of Dr. Forry R. Getz.

an atom of hard solder to retain it in position when swaged. Only enough solder to barely unite the several strips should be used. The

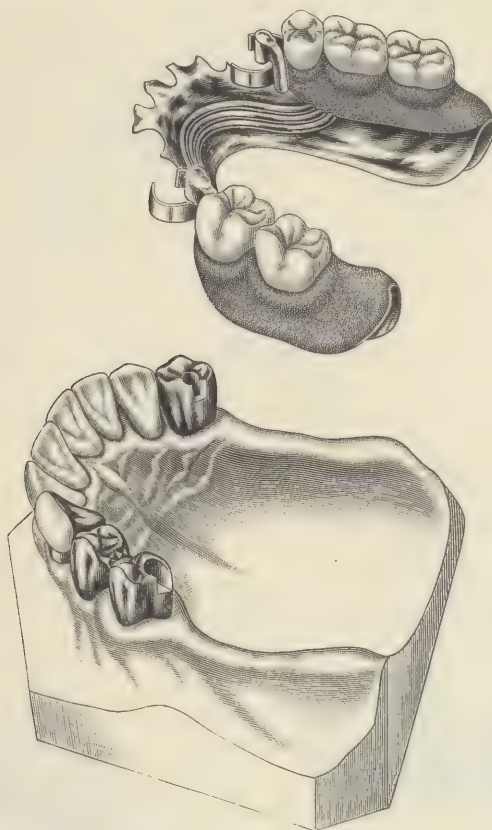


FIG. 910.

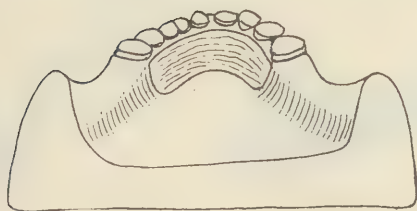


FIG. 911.

united strips are then trimmed to the required width, the edges rounded and the whole polished and given a final swage. A very rigid slightly

oval-shaped connecting link is thus formed and one that will offer the least possible obstruction to the tongue, as shown in Fig. 913.



FIG. 912.

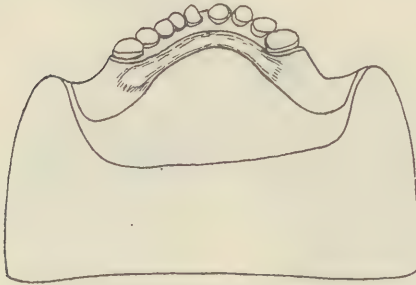


FIG. 913.

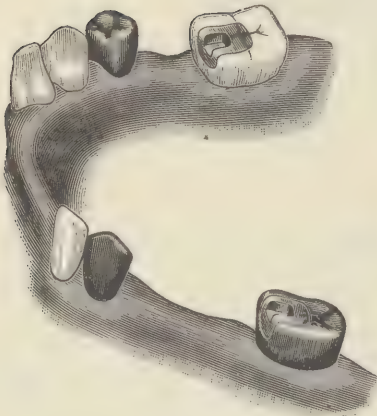


FIG. 914.

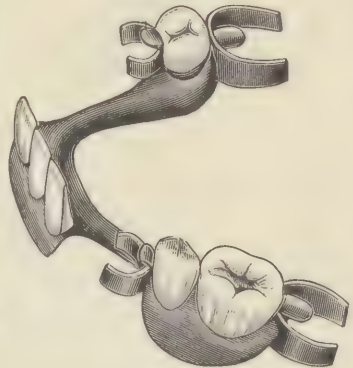


FIG. 915.

Figs. 914 and 915 show a lower removable plate bridge with clasp and lug attachments that was made to replace a cemented bridge. The method of the construction of the cemented bridge kept the mouth

in a septic condition, as it could not be properly cleaned by the patient, by whom the denture with which it was replaced has been satisfactorily worn for several years. Pressure of the narrow reinforced strip connecting the right and left sides of the plate was obtained as described in the preceding case.¹

To Correct Warping.—In removable plate bridge-work, if warping occurs in the soldering of attachments on opposite sides of the mouth, it should be corrected before the artificial teeth are attached. This was done in the case illustrated in Fig. 914, as follows: An impression of the

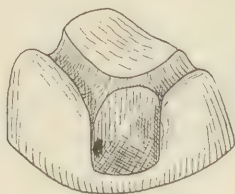


FIG. 916.

surface of the zinc die on which the plate was swaged was taken in plaster. On its removal from the die, the plaster around the locality of the clasps and attachments was trimmed so that the plaster mold would rest on the surface of the plate without touching them, as shown in Fig. 916. This impression mold was then cast in lead and used as a die to swage the plate against the zinc die and remedy the warping. Should any part of a die under the attachments interfere with the adjustment of the plate on the die, remove the metal of the die at those points with a file or coarse carborundum wheel.

A frequent cause of warping is immersion in water of an invested gold plate immediately after a soldering operation to gain time. The water absorbed in the hot investment material is instantly converted into steam. The steam explodes the investment material and by pressing against the surface of the plate tends to distort it.

¹ Case of the author's.

CHAPTER V

GENERAL APPLICATION OF REMOVABLE BRIDGE-WORK

The form and construction of removable bridge-work is further explained in its application to the following typical cases.

Centrals, Laterals and Cuspids.—Removable bridge-work methods of construction for replacement of a single superior incisor, seldom permit conservation of the pulp of the retaining abutment tooth. Fig. 917 shows one of the methods of constructing a removable central.

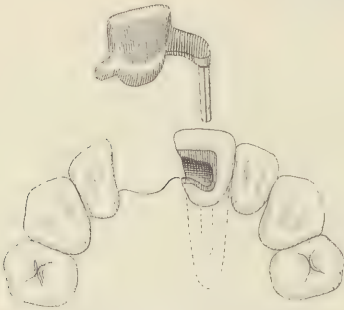


FIG. 917.



FIG. 918.

The pulp is removed from the adjoining central and an inlay tube and split post inserted to support the pontic central. A lug resting on the lateral is used to assist the abutment in resisting pressure in occlusion on the pontic central. Fig. 918 shows the bridge in position.

Fig. 919 shows another method in which a removable half-collar crown with a tube and split post is used for an abutment. The remainder of the construction is the same as in the preceding method. A filling or inlay for the lug to rest on is not always indicated. If injury results from the presence of the lug, a filling or inlay can at any time be easily inserted, as the denture is removable.

In cases of short teeth or forcible and direct occlusion, the restoration of a single central may demand the lateral in addition to the central as a retaining abutment, as shown in Fig. 920, in which inlays with tube and split-post attachments are used.

The restoration of a lateral is best effected by using the cuspid as a retaining abutment, as shown in Fig. 921.

The restoration of two centrals generally requires the support of the cuspids as retaining abutments. Bars are extended from the cuspids to the artificial centrals over the lingual side of the laterals, resting either on the surface or in a groove in an inlay.

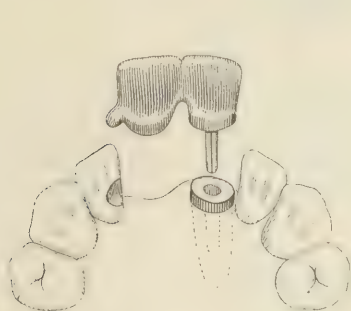


FIG. 919.

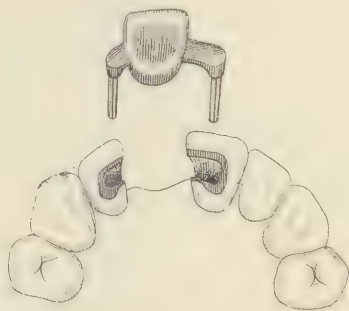


FIG. 920.

A cuspid pontic, to resist the force of occlusion, as a rule requires two retaining abutments, the bicuspid and lateral.

Bicuspids and Molars.—A first bicuspid is best replaced by a retaining abutment on the second bicuspid and a lug on the cuspid, as shown in Fig. 922, and in position in Fig. 923. A second bicuspid



FIG. 921.

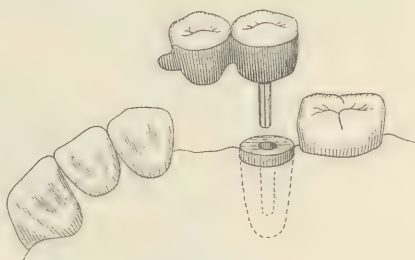


FIG. 922.

demand as a retaining abutment on the first molar and a supporting abutment additionally on the first bicuspid or the reverse. An attachment allowing pulp conservation can usually be applied to a molar (see T-shaped attachments, pages, 400, 406, 466).

The replacement of a lower second bicuspid and a molar with a saddle bridge is shown in Fig. 924. A porcelain-faced gold crown with

a split post was placed on the first bicuspid as the anterior abutment. As the second molar, forming the posterior abutment, tipped forward, an inlay was inserted with a removable T-shaped attachment.



FIG. 923.

A saddle bridge supported by abutment teeth with vital pulps is shown in Fig. 925; an inlay in the molar with a removable T-shaped attachment and a three-pin inlay with a small similar attachment in

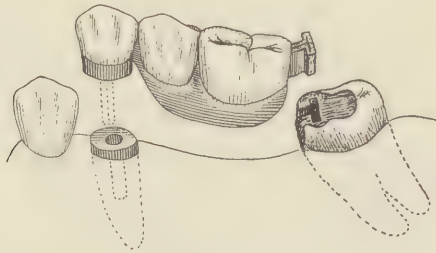


FIG. 924.

the cuspid securing the denture in position. As the attachment in the molar in this sized denture can be largely depended on to retain it, a partial clasp on the distal and lingual sides of the cuspid with a lug

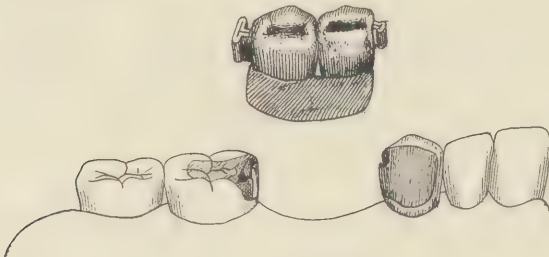


FIG. 925.

that rests in a slot in a gold filling in the lingual side will usually afford sufficient support to the anterior end, (see Fig. 901) or a V-shaped attachment might be used (see page 403).

Fig. 926 shows a case replacing the right superior first and second molars and the left second bicuspid and first molar, using T-shaped attachments in the molars and clasps with lugs on the bicuspid and

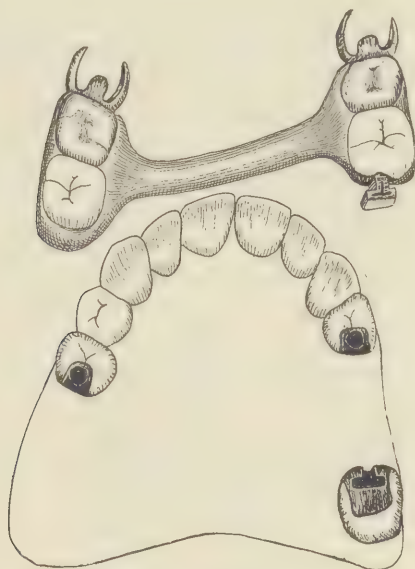


FIG. 926.



FIG. 927.

saddles. The extension saddle on the right side is connected by a bar to the saddle on the left side to counteract leverage and for additional support. Fig. 927 shows the denture in position.

This method of constructing superior dentures of right and left saddles connected by a bar is not regarded with favor by the author, who considers a gold plate covering a portion of the palate supported by clasps with lugs preferable. The latter form of denture lessens the stress on the abutment teeth or crowns and is not so complicated in construction. If the anterior portion of such a plate is removed, so as to leave a space between the edge and the anterior teeth of at least one-eighth inch, and the posterior edge is extended back a moderate distance, the additional portion of the palate covered compared to that covered by a bar will not make a very material difference to the patient. What is here stated respecting superior right and left saddles connected by a bar is also applied to a single right or left saddle from which a bar is extended to the other side of the arch and attached to one or two crowns to counteract leverage. When a saddle on one side is extended from the cuspid to the third molar the necessity for the last mentioned application of a bar is more indicated.

Connecting Bars to Saddles.—Such bars are made either by casting the bar of clasp metal from a wax model formed on a model made of investment material of the case, or by burnishing a strip of pure gold,

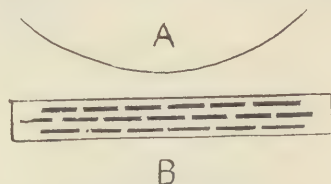


FIG. 928.

one-fourth inch or less wide, then bending to and soldering on its surface with hard solder, two, three or more pieces of the same length of gages 18 to 20 gold clasp wire. The gage of the wire and the number of pieces are to be regulated by the length and width of the bar.

The following method minimizes warping and insures a reliable bar: Cut a strip of pure or platinized gold, gage 30, of the required length, one-fourth inch wide, and adapt it to the intervening space between the saddles, as shown at A, Fig. 928. Cover the outer surface of the gold with wax, leaving the extreme ends exposed. Invest and remove the wax with boiling water and trim the investment so as to expose the surface except at the extreme ends. Place pieces of gold clasp wire of about gage 20, cut one-fourth of an inch in length, evenly over its surface, in three consecutive rows, with one-sixteenth inch interstices between the ends, as shown at B. When ready to solder, first place and fuse only a small quantity of hard solder in the center

and then gradually diffuse it to each side until all the pieces of wire are caught. Next, by degrees add more solder and shape the bar to the desired form. The bar is next trimmed and polished, when it is ready to be adjusted and united to the saddles.

Cast Saddles and Plates.—The formation by the casting method of saddle and plate bridge dentures for both sides of the mouth connected by bars is considerably practiced. In a case such as is shown in Fig. 913, and similar ones, the wax model having been formed, sprues are placed in the manner illustrated in Fig. 929. The wax pattern is chilled, or the pattern is formed on a model of investment material and cast on it, removed from the model and invested, using a large flask, and cast. A slight space should be provided for under the wax bar to allow for the settling of the denture when in use.

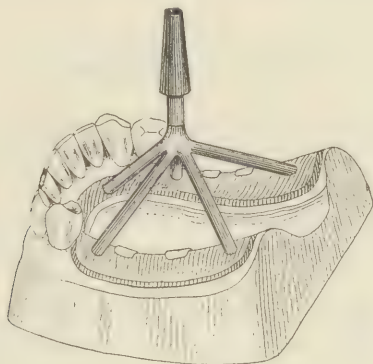


FIG. 929.

The preferable method of constructing dentures of the form shown in Fig. 914 is to first cast each saddle separately. Position each *attachment and saddle separately*, and take an impression with pressure on the saddle, remove, invest and solder attachment to saddle. *Adjust both saddles*, take an impression in plaster with pressure on the saddles, remove, make model and join the saddles with a connecting bar by soldering.

The formation of saddle and plate bridges with the clasps and lugs or other forms of attachments all in one casting is not approved by the author, for the reason that the denture will rest proportionately more on the abutments than on the alveolar ridge. The practice of scraping the model of the ridge to obtain the necessary pressure is also criticized, as uniform removal of the surface of the model is doubtful.

CHAPTER VI

MANUFACTURED ATTACHMENTS

To simplify the construction of removable bridge-dentures, especially of the saddle or plate type, several styles of ready-made attachments have been introduced and are manufactured. A description of the most used of such attachments will be here given, but only a limited statement respecting their application, as each manufacturer publishes directions that can be procured on application, giving such information in extensive detail.

The Roach Attachment¹

This is one of the simplest of the manufactured attachments. It is on the ball-and-socket principle, which greatly reduces leverage or tipping stress on the supporting teeth and obviates accurate paralleling. In use, while the denture is more or less retained, some degree of mobility is allowed. It may be classed as either a retaining or supporting abutment.

The Roach Attachment is made at present in three forms as shown in Fig. 930. No. 1, a true ball and socket, is heavier than No. 2 or No. 3,

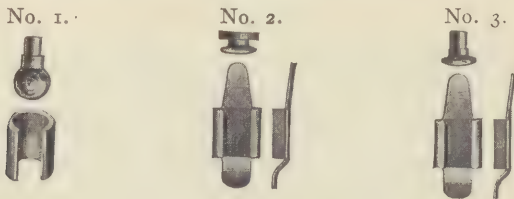


FIG. 930.

also stronger. It is specially intended for plate-work and the larger cases of bridge-work where great strength is desired. No. 2 is for use where there is but a small space between abutment teeth for the pontic or pontics. No. 3 is identical with No. 2 except that the button has a projecting stem with shoulders. In application the ball or button section is the one usually attached to the crown and the socket to the denture, but these positions may be reversed if conditions suggest it.

¹ Manufactured by the Dental Products Company, Chicago, Ill.

Fig. 931 shows the several parts of a Roach attachment No. 1 and Fig. 932 the attachment applied for an inferior partial denture.

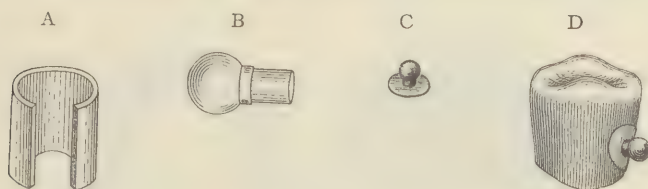


FIG. 931.

A is the socket.

B the ball with stem.

C ball with stem soldered to platinum disk.

D the ball soldered to a gold crown.

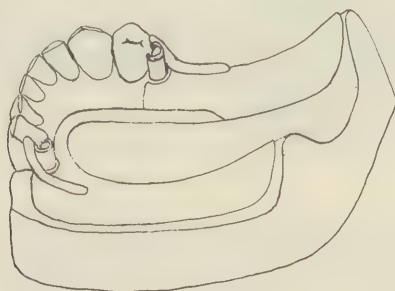


FIG. 932.

The Gilmore Attachments.¹—These manufactured attachments for this style of work consist of an assortment of clamps made of clasp gold to fit over bars, Figs. 933 and 934. They are made of platinized gold for attachment to gold dentures by soldering and with the addition of flanges for their retention when used with vulcanite.



FIG. 933.



FIG. 934.



FIG. 935.

The abutment roots are capped with a plate and root post and the teeth are capped with gold crowns. The bar to support the clamps is soldered to root-caps and gold crowns, as seen in Fig. 935. The ends

¹ The Detroit Dental Manufacturing Co., Detroit, Mich., Manufacturers.

of the bar may be extended beyond the abutment root-caps to afford additional space on the bar for more attachments, as seen in the case of a lower denture in Fig. 936.

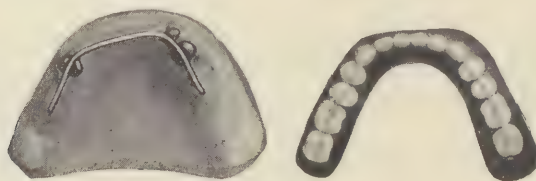


FIG. 936.

The Chayes Method and Attachments¹

In this method the intention is to impart a slight resilient mobility to the denture to permit it to respond to the vibratory as well as masticatory force of the maxilla. The denture is formed of a saddle and retaining abutments, which allows direct pressure of the saddle on the membrane of the alveolar ridge and also permits a slight rotary-lateral motion labio-lingually. For the construction of dentures of this style, the following described instruments and attachments are used.

The Parallelometer.—Fig. 937 illustrates an instrument for paralleling abutments and their attachments, also for measuring spaces.

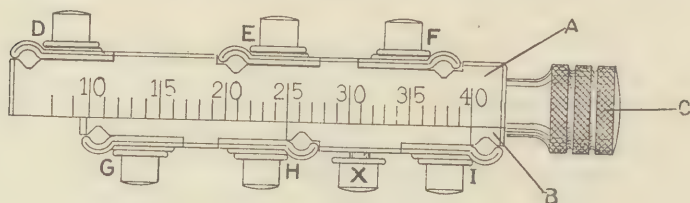


FIG. 937.

It consists of two sections or bars, the outer one, A, into which slides the inner one, B. The thumb screw C extends or draws back the inner section B. Fig. 938 shows the instrument extended. The body of the instrument is 40 mm. long and it can be extended to 55 mm. Each section has three clamps, marked D, E, F, G, H, I, for holding in place the mandrels for carrying the attachments.

The Parallelodrill.—Fig. 939 illustrates a right-angle attachment for the dental engine with sockets for two drills for enlarging or drilling root-canals in parallel lines. It is operated in conjunction with the parallelometer. The space between canals is measured by the parallelometer.

¹ Manufactured by the Chayes System Laboratories, 7 W. 45th St., New York

meter, as shown in Fig. 940, then the measurement transferred to the parallelodrill and the canals enlarged, as shown in Fig. 941.

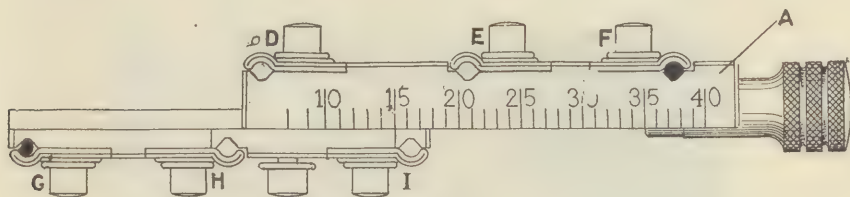


FIG. 938.

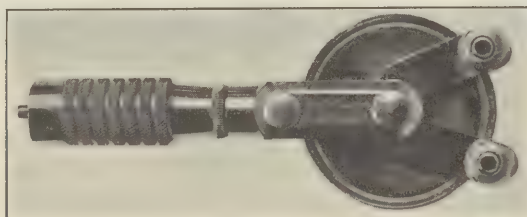


FIG. 939.

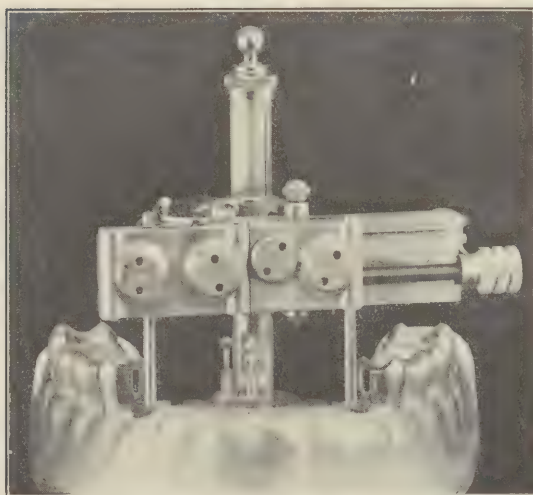


FIG. 940.

The Attachments.—The attachments consist of the bucco-lingual, upright and the distal extension. They are made in seven different sizes, some of which deviate in form.

The Bucco-lingual Attachment.—This is formed of a rectangular box of platinum termed the “hood” with a slot in the side facing the bridge, as illustrated at A, Fig. 942. The anchorage or friction sec-

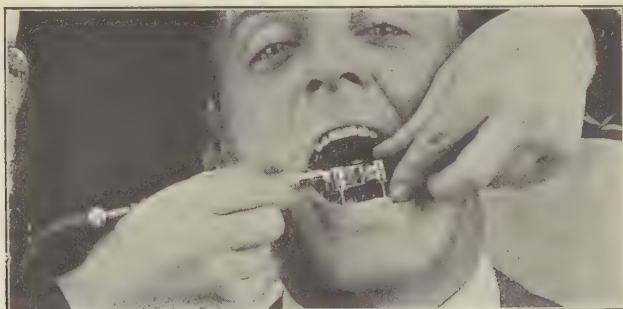


FIG. 941.

tion, B, fits into the “hood.” It is formed of elastic gold in the form of a T, as shown at B. The shank S is the part to be connected to the bridge. Fig. 943 shows the anchorage inserted in the hood, and Fig.

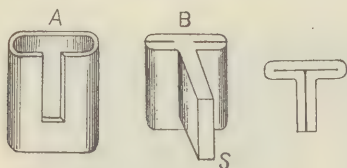


FIG. 942.]



FIG. 943.

944 the “hood” in position in an inlay in a molar with the anchorage inserted.

The Upright Attachment.—This consists of a flat split bar, as illustrated at A, Fig. 945, that fits into a seamless rectangular tube, B.

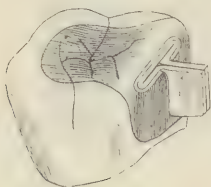


FIG. 944.

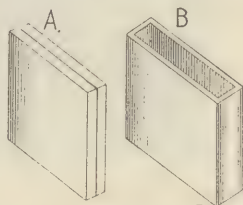


FIG. 945.

It is intended to retain the end of a bridge on a bicuspid or molar abutment, and is made in two corresponding sizes. Figs. 946 and 947 show the attachment applied to a molar crown.

The Distal Extension Attachment.—This attachment is illustrated partly in section in Fig. 948. One end of the bar (A) is united to the male section of a tube and split-post inlay attachment, in a right superior cuspid and the other end is inserted into a corresponding socket in the

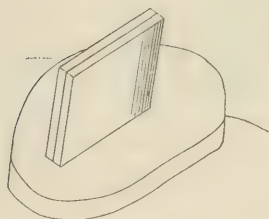


FIG. 946.

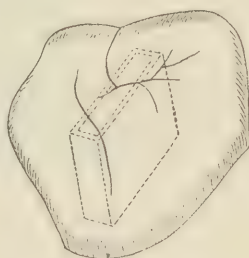


FIG. 947.

adjoining bicuspid pontic, where it is anchored with a screw in a counter-sunk cavity (S). An arched form is given a portion of the bar to allow it to move slightly in the socket so as to permit similar proportionate movement at that end of the bridge. Fig. 949 shows the attachment united to the side of an artificial crown.

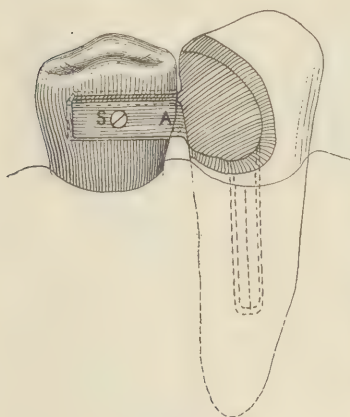


FIG. 948.

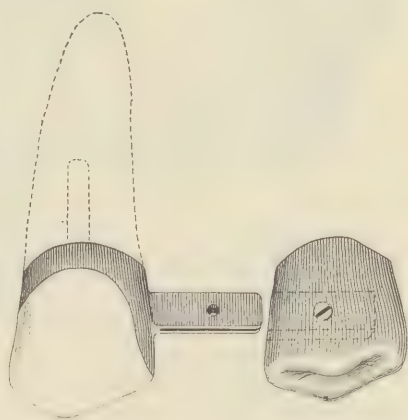


FIG. 949.

Application.—Fig. 950 shows a case with these attachments. In the construction the attachments are accurately paralleled when united to abutments and bridges. Fig. 951 shows the bridge in position.

In the finished denture, to permit the bridge to yield slightly buccally and lingually as well as vertically under the stress of mastication,

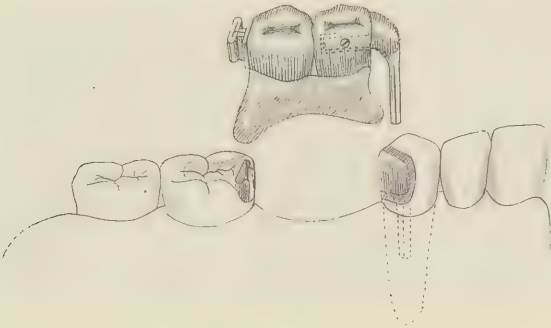


FIG. 950.

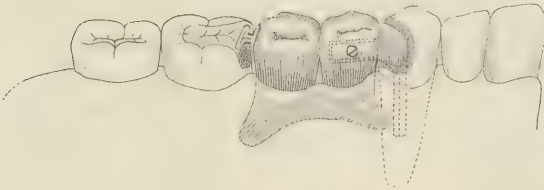


FIG. 951.



FIG. 952.



FIG. 953.



FIG. 954.

tion, the sides of the bucco-lingual anchorage in the molar (Fig. 952) are slightly tapered from the central part towards the ends.

Fig. 953 shows the Chayes method of shaping the end of a cuspid root and the form of cap applied. Fig. 954 illustrates a molar.

The Split-post and Bar Attachment¹

This attachment consists of a combined split post and bar. Fig. 955 shows the attachment enlarged. The split bar terminates with a split post, to which the bar acts in the relationship of a shank. The combined split post and bar fit into a platinum box or hood which sits in the abutment inlay or crown. The shank of the split bar is attached to the bridge.

Fig. 956 shows attachments as they appear united to the bridge, which is ready to receive the porcelain crowns (pontics).

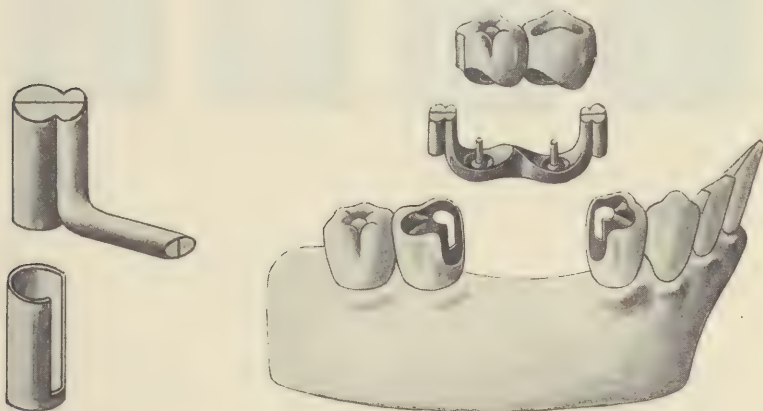


FIG. 955.

FIG. 956.

The Kayle Individual Movement Clasp Attachment²

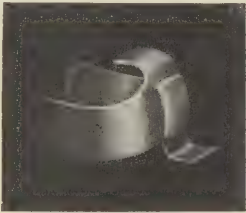
This attachment, shown in Fig. 957, is for the purpose of connecting a clasp to a denture in a manner that will permit the giving in the construction of a more or less tipping or lateral movement as the denture is adjusted in position, and to allow the denture to yield slightly under pressure in mastication.

This clasp attachment consists of three component parts as shown in Fig. 957. A is a machine-tooled platinum-gold pin with head and col-

¹ The Combined Split-post and Bar Attachments are manufactured by Mr. John Yirikian, 391 Central Park, West, New York, from whom descriptive details of their application can be obtained.

² Manufactured by Kinder-Lang Co., 220 West 42nd St., New York.

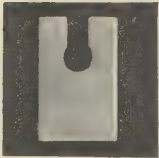
lar. B consists of a plate or protecting wall with cut out to receive pin, C shows the inside of a solid seamless shield or cap that fits over the other parts A and B, D shows the outside of the stud or cap.



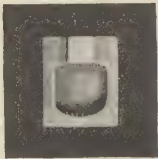
A



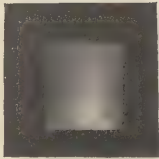
B



C



D



E



F



G



H



FIG. 957.

E to H show the three parts in successive stages of fitting the attachment to the clasp. The shank of the attachment is the part connected to the denture.

PART VI
PORCELAIN DENTAL ART

PORCELAIN DENTAL ART

INTRODUCTION

By porcelain dental art is here meant, not the well-known processes by which porcelain teeth bought from the manufacturer are mounted on metal or vulcanite base, but the actual working of the material porcelain, from the mixing of body and colors to the final baking. It involves the making by the dentist of partial crowns (including inlays) and entire crowns of porcelain. It is, in some degree, a return to the old vogue, when the dentist made the porcelain teeth which he mounted for his patients; but the present practice is upon a much higher plane, in which the artistic is one of the principal features.

Porcelain dental art, as here defined, is an outgrowth largely of the common adoption during late years of modern methods of crown- and bridge-work. At first, its possibilities not being clearly seen, its application was confined to a limited field, its sphere of usefulness widening as the processes became better understood and improvement after improvement was brought out. Latest methods in the manipulation of porcelain seem to leave little further that can be accomplished in special operations, so far as artistic merit is concerned. It is by no means intended to be suggested that the processes involved in porcelain dental art have been finally perfected, as improvements are quite possible, and may be expected.

The successful practice of porcelain dental art is not easy, as will be speedily appreciated by those who enter upon it. There is demanded a technical and manipulative skill and a judgment equal in degree to those required in any other class of dental operations, a fact which will serve only to stimulate the attainment of perfection in its methods.

In presenting the subject we shall deal first with the composition, properties, and methods of manipulating the porcelain compounds at present in use in this line of work, then with inlays and crowns.

CHAPTER I

PORCELAIN COMPOUNDS OR BODIES

Ingredients: Their Chemical and Physical Character.—The requirements of this line of work have developed a demand for a special class of porcelain bodies or compounds, made up of ingredients similar to those from which porcelain teeth are made and to those commonly used for continuous-gum work, but differing from them in that they are lower fusing, are very finely ground, and arranged in various colors. Inlay- and crown-work body is composed of silica, siliceous earth—the dioxid of silicon; feldspar, a double silicate of aluminum and potassium; kaolin, a silicate of aluminum, decomposed feldspar, and a mineral “flux,” generally composed of either flint or Bohemian glass or their compounds. Flint glass is made of silicate of potash, or soda and lead oxid; Bohemian glass, of a silicate of potash and lime. Glass of borax also is sometimes used as a compound in the “flux.”

Silica is highly infusible. It is used in a very small proportion as the foundation ingredient of porcelain to assist in retaining the body in shape during the fusing, and imparts structural strength.

Feldspar is quite fusible. It forms a much larger proportional part in the formation of porcelain than the other ingredients combined. It serves to agglutinate the particles of the more refractory compounds, silica and kaolin, and imparts a semi-transparent appearance to the porcelain.

Kaolin is infusible, but unites with feldspar at high temperatures when incorporated with it and is an element of strength. It is used in a small proportion to the other compounds as it imparts opacity to the porcelain.

Flux is incorporated to modify the infusibility of the other ingredients of the compound. A flux of the character of flint glass is much more effective in lowering the degree of fusibility of a porcelain body than one of Bohemian glass, which fuses at a higher degree. Flint glass, owing to the presence of lead oxid, has a tendency to cause discoloration of the porcelain in which it is compounded when used in the mouth. The character of the flux and the skilful proportioning of it to the other ingredients govern the fusibility, while maintaining the other characteristics of a porcelain body.

Low- and High-fusing Porcelain Bodies.—Porcelain body so compounded as to fuse below the melting point of gold and so permitting the use of a gold-foil matrix in inlay-work is termed “low-fusing.” One which fuses above that point and requires the use of platinum for the matrix is termed “high-fusing.”

Coloring of Porcelain Compounds.—Porcelain compounds are colored to imitate the shades of the natural teeth by thoroughly incorporating certain proportions of titanium oxid and preparations of oxids of gold, tin, platinum, iron, cobalt, uranium, manganese, silver, and zinc. The exact proportions or combinations of these materials to effect the desired shades in the different preparations of porcelain bodies is a matter of knowledge and skill which is confined to the individual manufacturers.

Gum Enamel.—Gum enamel is composed of oxid of gold (purple of Cassius), feldspar, and flux. The proportion and character of the flux incorporated in the compound regulates the fusing-point in this as well as in all porcelain enamels. Gum enamel gives surface form to an artificial gum as well as imparts color. It fuses at a slightly lower heat than the porcelain it is applied to. In this respect the gum-enamel used in the manufacture of porcelain gum teeth and in the construction of continuous-gum and porcelain bridge-work differs from what is termed pink or gum color stain, which latter is very finely ground and fuses at a comparatively low heat. As gum enamel fuses but imperfectly on the surface of platinum, the metal has to be first covered with a layer of porcelain body, which should receive what is called the primary bake before the application of the gum enamel.

Foundation or Basal Body.—Foundation or basal body is a term used to designate a preparation of porcelain body that is applied first to form the base or foundation of an inlay, crown, or bridge. The “Close” porcelain body used so extensively in continuous-gum work is an example of a foundation body.

The use of foundation body is usually confined to the foundation or internal portion of the work, although certain parts at times may be entirely constructed of it. Any moderately high-fusing porcelain body may be used as a foundation in association with one fusing at a lower temperature applied afterward. A foundation body is generally a shade darker than the body subsequently applied to accord in color with the portion of the work—the dentin of a tooth, for instance—it is calculated to represent.

Preparation of Porcelain Bodies.—Porcelain body is prepared and sold in bottles or jars in a set of about twenty-five different shades,

arranged in a case, such as is shown in Fig. 958, accompanied by a set of samples showing the colors which the various bodies assume when fused. Some sets additionally contain a bottle of gum enamel and one of foundation body.



FIG. 958.

Selection of the Color of the Porcelain Body.—The proper color of porcelain body should be selected from the samples while the tooth is wet, as dryness affects the shade. In inlay-work for approximal cavities in the incisors it is well to select a color a trifle lighter than that of the natural teeth, as shadows and the cement have a tendency to darken the appearance of an inlay. Should none of the colors shown by the samples correspond with the color wanted, it is customary to mix different shades of the porcelain body to obtain the one desired. Whatever color is required, first ascertain the basal color and to this add the toning material. For instance, taking yellow as the basal color, a variety of shades can be formed by the addition of white; others still, by the use of blue, and so on. To test a mixture of colors, drop a small pellet of the body, say about the size of an intended inlay, on a piece of blotting-paper to absorb the moisture, and bake it in the furnace. This can be done in about two minutes, and will positively decide the question of suitability. Insufficient fusing will render the porcelain a trifle darker than the true shade, and excessive heat will lighten it.

Sample Shades.—Special sample shades can be made at different times, and the formulæ entered in a book and numbered. Taking, for

instance, of the S. S. White colors, which are lettered from A to Z, one part of M to three parts of G, the combination may be numbered IX, and is written $1M + 3G = IX$. The colors are mixed to a doughy consistence on a slab, and a mold made of fusible metal, such as is shown in Fig. 959, slightly oiled, is pressed down on the mass and removed. The surplus is then trimmed at the edges and the porcelain baked, resulting in a sample such as is shown. A simpler way for many, though, will be to shape the mass of porcelain on a flat piece of platinum plate, approximating the form shown at A in Fig. 959. Flatten one end, and make a hole with an instrument. Flaws can be repaired by a second baking. The sample shade can be marked, as shown, in Roman numerals with a disk. If the point of the sample



FIG. 959.

is ground, as shown at C, the indentation can be covered with oxyphosphate, and change of shade, if any, will be exhibited.

Variation in Shade.—A difference in shade between the region of the cervix and that of the incisal or occlusal section, the latter being lighter and more translucent, is characteristic of the human teeth. An imitation of this variation of shade in any small inlay is unnecessary, but in the case of an incisor where the operation involves the restoration of a large part of the side of the tooth including the incisal edge, it is desirable. To effect it in an inlay, the same method is practiced as in the formation of American artificial teeth. The first application of body to form the upper and inner section is made yellowish in shade¹ to imitate the dentin of the tooth, and the succeeding ones, especially toward the incisal edge, of lighter and more translucent shades.

Stability of Shade in Use.—Stability of shade in use is assured in high-fusing porcelain, while change is liable to occur in the low-fusing as time passes, especially should the oxid of lead be used as an ingredient in the flux.

Spatula and Brushes Used.—A small tapering-pointed spatula of the ordinary form, or one with a corrugated handle for the purpose

¹The "Close" body when used for this purpose should be ground finer than it is as sold by the manufacturer.

of vibrating the shank or handle of the appliance supporting the work during the application of the body, is the most suitable (Fig. 960). Camel's-hair brushes, such as artists use for water colors, are also necessary. They should be of three sizes, the smallest for carrying and applying the mixed body, especially small portions where an application or addition is to be very delicately made, to some desired spot of the work; also for whisking an edge or small corner free of surplus particles of the body. The medium-sized brush may be similarly used, or in the same manner as the large size, which is only applied dry for brushing the surface of the body and metallic frame-work to free it from particles of the body.

Preparation of Porcelain Body for Use.—In the preparation of porcelain body for use absolute cleanliness is necessary, as the introduction of the slightest particle of foreign matter is liable to destroy the appearance of the work. The required quantity of the powder is placed on a flat or slightly concave glass or glazed porcelain slab and mixed with distilled or, in its absence, filtered water, applied from a drop or pipette bottle (Fig. 961). The consistence of the mixture should be that of a soft dough. To obtain this consistence the surplus moisture can be absorbed by light pressure of the corner of a napkin or a piece of blotting-paper against the body. Alcohol is directed instead of water for mixing the Jenkins porcelain, but rapid evaporation is all there is to recommend it, and this is an objection in the application of the body in some styles of operations.

Use of Gum Tragacanth or Starch.—In contour work a small proportion of a solution of gum tragacanth or starch is sometimes added by operators to aid in holding the particles of the body in form as the moisture is evaporated.

Application of Porcelain Body.—The porcelain body is carried and positioned on the work with the pointed portion of the spatula or with brushes. In the application as thorough a condensation or packing of the particles as possible is desirable. This is best effected by placing the mixed body, of a dough-like consistence, a little at a time, and then precipitating the particles by vibration



FIG. 960.



FIG. 961.

by tapping the shank or handle of the clamp

or tray holding the work with the side of the spatula or by drawing over it the corrugations on the handle of one such as is shown in Fig. 960. After each vibration the moisture that appears on the surface is absorbed with a small piece of blotting-paper. The further details of the process will be given when the application of the body to the different forms of the work is reached.

CHAPTER II

FURNACES

Furnaces.—A proper furnace is essential in baking porcelain. Small electric, gasoline or gas furnaces or ovens especially designed for use in connection with crown- and inlay-work operations are the styles used. A furnace to meet all the requirements for general work should be capable, if necessary, of generating a heat approximating 3000°F. , as some operations in porcelain may require a degree of heat approaching that.

Electric.—In electric furnaces or ovens the heat is generated by means of the resistance of fine platinum wire coiled free of contact around a fire-clay muffle. The wire is embedded as it encircles the muffle or is passed through small channels in the clay, and the muffle is enclosed in a frame-work of fire-clay or iron or both combined. The electric current is controlled with a rheostat, through which it is applied gradually in heating up to prevent fusing the platinum wire. At first the handle of the rheostat should not be moved beyond the first button for at least one minute. After that it may be further advanced more rapidly on the other buttons until the required heat is generated. The platinum wire around the muffle needs to be renewed at intervals, the necessity for renewal depending on the frequency of use, the quantity of current, and the care exercised in its application. Only fire-clay slabs should be used in an electric furnace as those of metal are liable to form a short circuit and fuse the platinum wire. Fig. 962 illustrates the S. S. White electric furnace of a size suitable for inlays and crowns.

Gas.—Gas furnaces made with seamless platinum muffles are used in preference to clay, as the required heat can be obtained in them in from three to five minutes. A platinum muffle, although seamless, will not assure against the gassing of porcelain. Fig. 963 illustrates the "Land Midget Gas Furnace," operated with foot-bellows.

Gasoline.—The gasoline furnace is now being given preference over the gas. The maintenance of heat production is dependent on a pneumatic pump. The muffle is made of either fire-clay or nickel, the latter, of which the Brophy, illustrated in Fig. 964, is an example, being preferred.

Use of Furnaces.—The gasoline and gas furnaces require to be well heated before being used. This is necessary to rid the muffle of gas fumes present in the first part of the heating. The draft should always be sufficient to entirely consume the gas and carry off the prod-

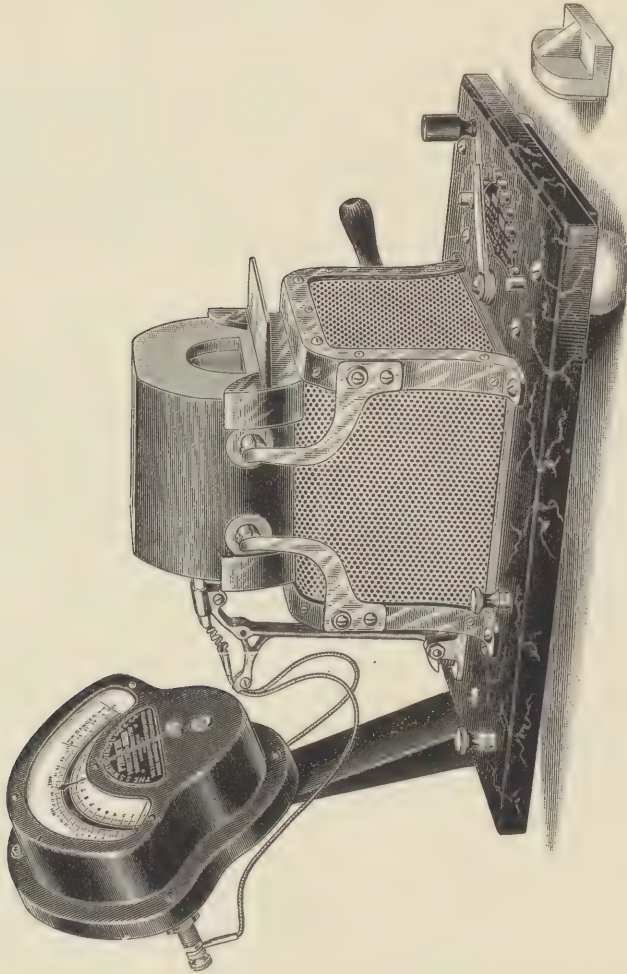


FIG. 962.

ucts of combustion. If this is neglected, or if the furnace is defective, gases are liable to penetrate the interior of the muffle and affect the color and character of the porcelain by "gassing" it, a condition to be corrected only by substituting new materials. In the use of electric furnaces, owing to the purity of the heat generated, this precaution is not

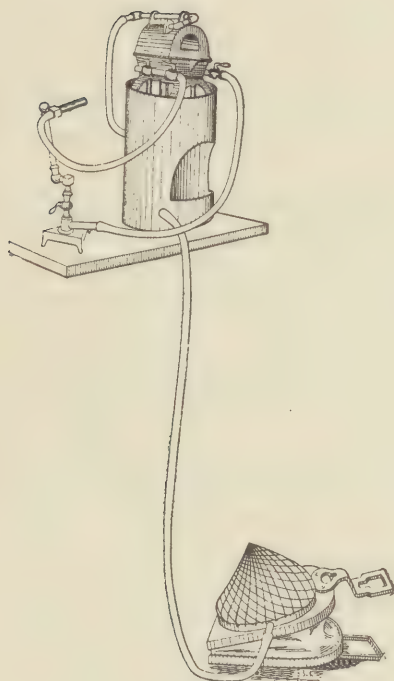


FIG. 963.



FIG. 964.

necessary. The work may be safely allowed to cool gradually in any of these forms of furnaces by turning off the heat supply.

For fusing porcelain that requires a heat close to 3000° , a gasoline or gas furnace has the advantage over the electric, owing to the fact that such a degree of heat in time burns or melts the wiring of the electric.

Advantages of the Electric Furnace.—The electric furnace, owing to the form of its construction, places the heat under perfect control and admits of its accurate regulation by the pyrometer. In these respects it possesses advantages over the other styles in use.

Dental Furnace Pyrometer.—The pyrometer is an instrument that indicates the degree of heat in the muffle by a needle on the scale of the register. By its aid the gradual increase and exact degree of heat are determined with a certainty impossible by other means, and more especially by the eyes in such small muffles as are used for porcelain inlay or crown-work. The Fahrenheit and Centigrade scales are printed on the register. The needle that registers the degree of heat is operated by an extremely mild current of electricity generated by a thermo-electric couple inserted through the back of the muffle. The couple is composed of platinum and rhodium brazed together. It is claimed that the combination of these two metals is the most effective known for the purpose. The instrument shows delicacy of construction and precision in registration. When the furnace is in use, if the door is opened or the current shut off for a moment, the change is instantly indicated by the needle on the scale of the register.

CHAPTER III

FUSING OF PORCELAIN

Importance of the Operation of Fusing.—The baking or fusing of the porcelain body is one of the most important factors in porcelain work, as the result, as a whole, depends on its successful performance.

Density, strength, shade, and surface gloss and finish are affected by, and dependent on, the proper conduct of fusing.

Too rapid heating or overheating will affect the density and strength by causing porosity and brittleness; and insufficient fusion will impair its crushing strength and gloss.

The given shade of any porcelain compound depends on its fusion at exactly the heat intended for that special preparation.

Twenty-five degrees higher or lower comparatively lightens or darkens it.

The glaze is defective if insufficient heat has been applied, and a glass-like appearance is imparted to the edges by overfusing.

Shrinkage.—All porcelain compounds shrink in fusing. The tendency of the low-fusing is to ball or assume a spherical form, and of the high-fusing to contract from the edges.

These tendencies are attributable to the proportion and especially the character of the flux of the two grades, that of the low-fusing being largely composed of the component parts of glass. In the construction of work most of the shrinkage occurs in the first fusing, in which it ranges from about 40 per cent. in the low- to 25 per cent. in the high-fusing.

The shrinkage of all grades of porcelain bodies is much lessened by a thorough condensation or crowding together of the particles as they are applied before the fusing.

Baking or Fusing.—All grades of body require at least three bakings or fusings to allow the several shrinkages which occur to be corrected and to effect a proper vitrification of the particles.

The first fusing is termed the "biscuit bake;" the first and second, "primary bakes;" and the last, the "final bake."

The character of the work at times may require more than two primary bakes before it is ready for the final bake.

Requirements in Baking.—In the first bake, and likewise in all subsequent ones, the work should be first slowly heated so that all

moisture in the freshly applied body is evaporated by degrees and not suddenly forced out by its expansion as steam.

If such care is not taken, particles or sections of the body are liable to be loosened and misplaced or blown off, thus impairing the form of the work and engendering porosity. The work should be first set on a small fire-clay slab, or in a tray, and placed on the shelf a little to one side of the muffle, and very slowly heated to effect evaporation of moisture, which is indicated by the dry and lightened shade of the body. It is then moved to the center of the shelf, heated by degrees, and introduced into the muffle. If an electric furnace is used, the work may be placed in the muffle before the furnace is heated and the electric current connected, the voltage gradually increased, and the work allowed to heat up with the muffle,—a method, however, which should not be attempted with a gas or gasoline furnace. When the body has assumed a red heat, it may be moved quickly to the center of the muffle or a trifle beyond it, to a point which is generally the center of the greatest amount of heat.

First Bake.—In the first or “biscuit bake” the body for inlay or crown-work should be fused a trifle more than is generally accepted as sufficient in the corresponding baking of porcelain teeth or continuous-gum work. The fusing process should be so conducted as to cause the maximum shrinkage of the body and the particles to become solidly united, but with the mass still slightly rough and glossy on the surface, though not glazed. To accomplish this the work must be carefully watched and instantly removed at the proper time or the heat shut off. If allowed to remain in the furnace until the fusing point is reached, the quality and appearance of the porcelain are liable to be impaired by the final bake.

The heat required for the biscuit bake is graduated to be about 100° F. for the low- and 200° F. for the high-fusing below their respective actual fusing points.

Second Bake.—For the second bake, the shrinkage which takes place in the first is compensated by the application of additional body, and the work is again baked, using the same precautions in heating as before.

In the second bake, more heat may be applied than in the first. In the case of a low-fusing porcelain, the heat may be raised to within 25° to 50° F. of the actual fusing point, and in the high-fusing to within about 100° F.

Final Bake.—For the final bake, body is again applied at all imperfect points, and the work is gradually heated until the actual fusing point of the body is reached. It is then allowed to remain at that heat

until the porcelain assumes a smooth, glazed appearance, when it should be immediately removed or the heat shut off. It should be here noted that a gloss slightly deficient in brilliance is preferable to an excessive lustre, as the former can be increased by polishing, if desired. The time required to glaze the porcelain after the fusing point is reached is about ten to twenty seconds.

Cooling and Annealing or Tempering of Porcelain.—After each bake, and especially the final one, the porcelain should be cooled slowly. This can be done by removing the work from the furnace and inclosing it in a cooling muffle or by placing it under a small cover to protect it from the air. A better plan in the final bake is to turn off the heat of the furnace and allow the work to cool in the muffle until the red glow has disappeared before removing. After the last bake the porcelain is annealed or tempered, as it is termed, by turning off the heat of the furnace and allowing the work to cool slowly in the muffle of the furnace. All porcelain, after the final baking and cooling, should be dipped in water before handling.

Difficulty Attending the Proper Fusion of Small Masses of Porcelain Body.—In the baking of porcelain body of a size such as is applied in continuous-gum work, the process of fusing can be more easily watched and its progress more surely determined than in the case of a crown or inlay. A small mass of porcelain body of the size of an inlay is more quickly affected by the heat than a larger one. To always regulate the degree of heat by the eye alone and also determine the fusion, especially of the high-fusing porcelain body, in such cases with certainty is difficult and requires extensive experience.

Removal of the work from the muffle to examine it instantly cools such a small mass, and several removals for inspection are very injurious to the porcelain.

Method Used to Indicate Point of Fusion.—The melting points of gold and its alloys with platinum may be used to test the correctness of the scale of a pyrometer or to indicate the fusing of porcelain compounds by first making experimental comparative tests. The fusing point of the metal used to indicate the heat requires to be a few degrees below that of the body for the biscuit bake. The gold or its alloy is fused in a globule and then flattened out on an anvil with a hammer. The metal, after being tested with the porcelain, is placed upon the slab with the inlay or crown. When the metal assumes the spherical form, which can be seen by glancing in the muffle, it indicates that the fusion of the porcelain body has commenced. The globule of metal can be used continuously in subsequent bakings by flattening it out each time

Merits of a Pyrometer.—The introduction of the use of a pyrometer obviates the need for such methods as are described above. By the pyrometer the progress of the increase of the heat and every variation of it are instantly and correctly indicated to the operator. Any degree of heat can be accurately applied and regulated for any specified length of time. The various bakings accordingly can be conducted so as to result uniformly. Doubt and uncertainty regarding fusing are removed and the work simplified.

In baking with an electric furnace associated with a pyrometer, as soon as the work is placed in position in the muffle, the door is closed and it is hidden from view. The voltage is then gradually increased by manipulation of the rheostat, and the progress of the heat is indicated by the needle on the scale of the instrument. When the needle has registered the required degree of heat, the current is shut off, the door of the furnace opened, and the work is removed or allowed to cool in the furnace. The subsequent and final bakes can in like manner be given without variation from the proper degree of heat and time required for them, without once opening the muffle for the purpose of examination. Chilling of the work, irritation of the eyes by the glare and heat of the muffle through opening it for examinations, and loss of time are consequently avoided. Irregularity in the application of the degree of heat in the fusion of the body of porcelain work is the direct cause of a large percentage of failures. Improper conduct of a primary bake cannot be entirely remedied by subsequent fusings, and the final bake may destroy the previous part of the work. The best results respecting strength, appearance, and shade in the use of any particular porcelain compound can only be obtained by fusing it at the degree of heat specially designated for it. In view of the facts presented, the introduction of the pyrometer, especially for inlay and crown-work, in the use of high-fusing porcelain, was an important innovation.

CHAPTER IV

STAINING OF PORCELAIN

Character and Purpose of Mineral Stains.—Mineral stains are porcelain enamels colored with oxids of the metals, very finely ground, and fusing at a low heat. They are applied to reproduce the effect of conditions found in nature; as, for instance, staining of edges and cusps to assimilate the wear through mastication; of the fissures of bicuspid and molars to represent the discolorations which appear in these places in the natural teeth; producing variations in color, such as the darker shade of cuspid when compared with centrals or of the cervical surface with the incisal edge or occlusal surface; the white specks often noticeable in the natural teeth; and, in general, the modifying or darkening of a single tooth or a number of teeth.

The colors of The S. S. White Dental Mfg. Co. are brown, yellow, gray, blue, white, black and green, and pink for gum shading (Fig. 965). By combining them one can get a great variety of shades. Mixing brings out the colors very nearly as they will appear when fired, the firing merely intensifying and fixing them. By the skilful application of these stains artistic effects can be produced. Their successful use, however, requires practice and care. More than a little experimental work is necessary, and tests on a discarded tooth should first be made, as it takes but a few minutes.

Use of the Colors.—In applying the stains, if the tone of the tooth is yellow, the addition of brown will at first darken the yellow, then, as more and more is added, bring out a more and more decided brown.

If the tone is blue or gray, brown at first merely deepens it, but on the addition of a considerable quantity produces a decided brown.

The white spots frequently seen in the enamel of natural teeth can be imitated by applying a thin layer of white, stippling, and firing in.

For representing the wear of mastication the teeth are ground and the cutting-edges and fissures stained brown.

Defects in the enamel, as pits or grooves, can be imitated by drilling out—use a diamond drill for this—applying the color, and firing.

A combination of the green with the brown will give a natural-

looking stain similar to that found upon the teeth of inveterate "smokers."

Inlays or crowns, the color of which fails to match their surroundings, in some cases may be brought to the desired shade by the addition of the proper color and firing.

Natural "cutting-edge" effects may be obtained by using either gray or blue as an underglaze color, *i. e.*, after applying and firing the color, cover the same with a colorless medium- or high-fusing porcelain and again fire.

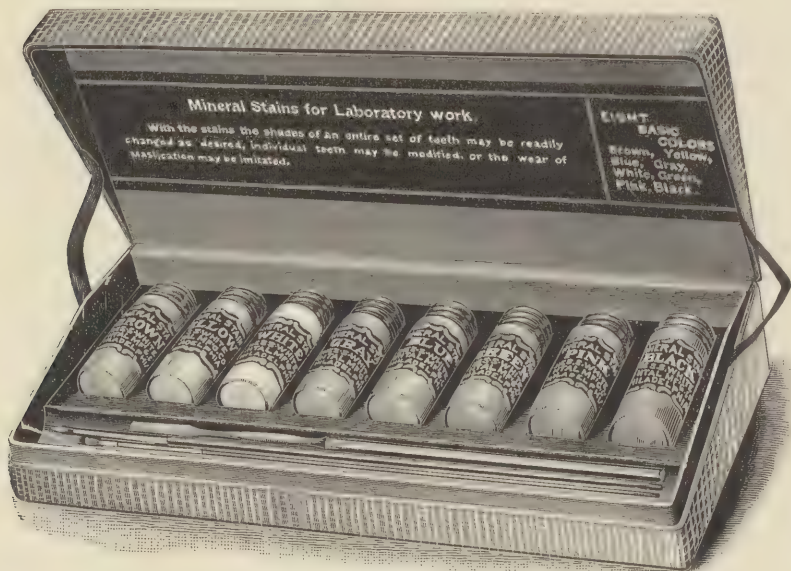


FIG. 965.

The pink or gum color will be found useful in covering platinum bands which are exposed below the gum line, also in coloring that portion of an inlay which lies under the cervical margin, and in disguising the necks of porcelain teeth whose cervical margins are above or below the adjoining teeth.

Application.—The enamel stains are applied with a small brush and evenly distributed over a given surface with a stippling brush, both of which accompany the outfit of stains. The colors are intended for use on perfectly fused surfaces, but they may also be applied after the biscuit bake or primary bake, and the tint then modified by the translucency of the additional body, which will be distributed over the part for the subsequent bakes.

A change of shade of only a part of a facing toward the incisal edge in the construction of a crown or dummy may be effected in this way by the application of the stain to the palatal side of the porcelain.

Gradation of Shade.—Gradation of shade is controlled by varying the thickness when laying on the color. This can be effected by placing on the color with the small brush and then graduating it with the stippling brush. It can also be done by wiping the color off with the fingers. To effect gradation of shade, for instance, around the neck of a tooth, with perfect accuracy, the color can be first evenly applied to the part and given a primary bake. The surplus color toward the edge is then removed with a sandpaper disk, making it gradually lighter, when the final bake is given and the enamel glazed.

Fusing.—In fusing the applied mineral stains, place porcelain teeth with the pins downward on a fire-clay slab, or, if a crown, set it upright. Apply the heat gradually until it reaches a dull red, and hold it at that point for two or three minutes. Cool gradually. These colors, though glazing at a low heat, will well retain their shade when fused on or with porcelain at a much higher point.

CHAPTER V

CHARACTER AND SUITABILITY OF LOW- AND HIGH-FUSING PORCELAINS FOR INLAY- AND CROWN-WORK

Requirements.—The value of the respective grades of porcelain for the work in hand is governed by their imitation of tooth-substance, density, strength, permanence of structure, retention of form in the process of fusing, close adaptation of the finished inlay to the margin of the cavity, and lastly—a most important factor—practicability in application. Porcelain dense and strong enough for use as an ordinary labial inlay might be deficient in the properties requisite to the formation of, for instance, an incisal edge for an incisor tooth, which would demand the greatest possible strength that can be obtained in porcelain. Neither would porcelain body designed to form an incisal edge, approaching in character body such as composes porcelain teeth—the pulverized porcelain tooth used at times by some for the purpose requiring a most intense heat to fuse it—be as suitable, even judged from a practical standpoint, for forming an inlay.

Comparative Merits.—The comparative merits of low- and high-fusing porcelain for the work in hand is a matter as to which considerable difference of opinion prevails. This is probably attributable to the fact that the knowledge or experience of many operators is confined in a measure to the grade they have in use and the methods connected with that use. Skilful proportionment and preparatory fusing of the various ingredients of a porcelain body realize the best results in the fused porcelain. In this way the fusing point of some preparations may be lowered, yet their comparative qualities be maintained.

Fusing Points of Dental Porcelains¹

The following is a revised list of the fusing points of the present best known dental porcelains:

¹ The percentages of shrinkage and crushing strength in pounds given, are the results of a series of experiments made by Dr. D. O. M. LecCron.

	°F.	Percentages of shrinkage	Crushing strength, pounds
Ash & Sons low-fusing	1550		
Ash & Sons high-fusing.....	2012	34 $\frac{3}{4}$	22.810
Close's foundation	2288	21 $\frac{3}{4}$	45.640
Consolidated Dental Mfg. Co.'s foundation.....	2200	21 $\frac{1}{2}$	30.390
Consolidated Dental Mfg. Co.'s Inlay.....	2138	31	15.080
Jenkins' Inlay.....	1580	38 $\frac{1}{4}$	28.305
Whiteley's inlay.....	2200		
S. S. White Dental Mfg. Co.'s foundation.....	2400		
S. S. White Dental Mfg. Co.'s high-fusing.....	2300	23 $\frac{1}{2}$	32.205
S. S. White Dental Mfg. Co.'s medium.....	2200		
S. S. White Dental Mfg. Co.'s special.....	2560		

Suitable Application of Each Grade.—According to the conditions discussed, in the present development of the art the use of low-fusing porcelain is best confined to inlays at labial and approximal surfaces. It is inferior to a moderately high-fusing porcelain for inlays that include the incisal edge and for porcelain and platinum crown-work, where porcelain nearly analogous in structure to the usual artificial crown is required.

CHAPTER VI

PORCELAIN INLAYS AND CEMENTATION

The Earlier Methods.—The first operations in porcelain inlays or fillings consisted in shaping pieces of porcelain as nearly as might be to the form of the prepared cavity, into which they were then cemented. These inlays were cut from porcelain teeth, which were selected to match the natural teeth into which the inlays were to be inserted. Various forms of inlays were then put upon the market by the manufacturers to meet the needs of this class of work, which, however, never attained any special prominence. A little later, slightly tapering round rods of porcelain were supplied for filling labial cavities in front teeth. The cavity was made perfectly round, to fit the end of a rod corresponding in size, which was fitted tightly, cut off, cemented in place, and when the cement had set was trimmed evenly with the surface of the enamel of the tooth. This latter method is still employed, being especially adapted to very small cavities on the labial surfaces.

Then we had glass inlays, of which a number were brought before the profession, but they failed to show the permanent value requisite, mainly because the inlays, besides lacking the necessary strength, showed a decided tendency to discolor in actual service. They were, nevertheless, an important step in the progression which led up to the modern porcelain inlay.

Modern Inlays and Their Merits.—The porcelain inlay as now used is a dental porcelain fused in a carefully made matrix of the cavity to be filled, of the exact form and size required. The two grades of porcelain for inlay-work are the low-fusing, for which a gold or platinum matrix is used, and the high-fusing, requiring a platinum matrix. Their respective merits for inlay-work have been much discussed, without deciding the difference of opinion concerning them. The characteristics of both and the methods of their manipulation and their application to the various operations will be impartially presented.

Properly made and inserted porcelain inlays afford the very decided advantage of restoring lost tooth-structure not only in substance, but in appearance. Porcelain is a non-conductor of heat and electricity and is not affected by oral secretions. In these respects it is superior to gold as a filling for natural teeth. Porcelain inlays are used principally on the labial, buccal, and approximal surfaces of teeth from bicus-

pid to bicuspid. They are also used on the occlusal surfaces of bicuspid and upon the anterior approximal sides of molars where the tooth immediately in front is missing. In combination with the cement used to fix them they add strength to a frail tooth and prevent thermal shock in sensitive cavities.

The first requirement in a porcelain inlay is that it shall accurately conform to the shape of the cavity, with an absolute fit of the orifice and side-walls. The cement with which it is luted fills in all parts of the cavity not occupied by the porcelain, including deep recesses and undercuts. The inlay is consequently held in position by the adhesion of the cement.

In cases of cervical decay extending under the gum-margin, the cavity should be previously packed with cotton or gutta-percha and the gum pressed from its normal position sufficiently to fully expose the edge of the cavity and admit of the perfect adaptation of the matrix or the taking of an impression for a model. In approximal cavities the teeth should be previously separated well apart—more so, as a rule, than for gold filling-operations—so that the adaptation of the matrix or its removal shall not be obstructed nor the insertion of the finished inlay interfered with in the slightest degree.



FIG. 966.

When the decay extends on the root further under the gum than it is desirable to extend the inlay, the cervical section of the cavity may be first restored with a gold inlay or with amalgam (Fig. 966) and then the coronal portion shaped and inlaid with porcelain.

Instruments and Materials Used in the Adaptation of Matrices.—Small-pointed and specially-shaped burnishers are necessary for the proper adaptation of matrices to cavities. Fig. 967 illustrates a set devised by Dr. LeCron. Nos. 1 and 11 are for general use; Nos. 2, 3, 4, 5, and 6 for the interior of cavities; Nos. 7, 8, 9, and 10 for the margin of the cavity and the surface of the tooth combined. Fig. 968 shows ball-pointed tweezers for carrying pellets of spunk or cotton used to compress the foil for the matrix into the cavity of the tooth. They may also be used as a burnisher.

Preparation of Cavities.—Cavities for porcelain inlays are prepared about as for gold inlays, as described in Part III, Chapter XVI. The effort should be to give a cup-shaped formation with the orifice a little larger than the bottom, so that the matrix of gold or platinum when adapted to the cavity can be removed without disturbing its shape. This ideal form is not to be obtained by excessive removal of the walls or enamel. Unnecessary cutting away of tooth-substance is to be avoided. When the decay has proceeded in such

way as to form deep recesses, it is not desirable nor necessary to cut away the tooth to make the ideal cavity form include them. After removing the carious portions from such recesses, they can be filled with cement so that the cup-shaped form for the matrix shall include only the main cavity, the cement where it joins the main cavity being dressed to conform to the proper contour. The exception to this rule is where a bar or horn-like formation of the porcelain is made at some point as an anchorage to an inlay which involves restoration of the contour of the working surface of the tooth, as of an incisal edge. If a cervico-labial cavity is given a slightly oval or oblong form, with one end or side differing somewhat in shape from the other, it will define the exact position the inlay is to occupy when inserted in the cavity. The margins should be trimmed evenly and the side-walls inclined at nearly a right angle to the line of the enamel surface, especially at a

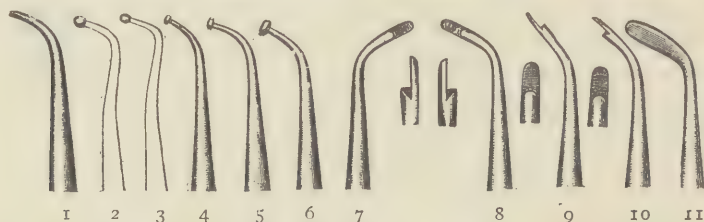


FIG. 967.

point where the force of mastication is to be withstood. The surrounding edge of the enamel should be sharp and well defined. It is well to polish around the margins inside the cavity with soft iron burs charged with diamond dust, or with points of Arkansas stone kept wet during the polishing. A set of forms such as are illustrated in Fig. 415, Part. III, Chapter XVI, are suitable for the purpose. The use of sandpaper disks or strips across the surface of the enamel should be avoided, as it is apt to make a coarse joint.

Figs. 969 to 972 illustrate teeth with prepared cavities and their inlays of the classes commonly involved in the practice of porcelain work.

Fig. 973 outlines, in section, the preparation of an ordinary cervical cavity. The line A A represents the prepared cavity; B B the point where the undercut—though this is generally better omitted—may be made when the porcelain is ready for insertion. C C is the gold or platinum matrix. Such cavities require to be moderately deep, in order that the inlay shall be of sufficient thickness to overcome the effect of the cement, which would otherwise modify the shade, owing to the translucency of the porcelain. A cavity of this character, unless

it is located very close to the gum-margin, being one of the simplest, is generally the best to begin practical work on.



FIG. 968.



FIG. 969.



FIG. 970.

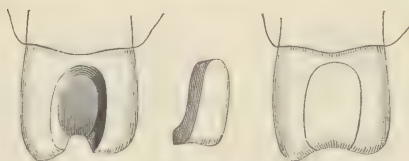


FIG. 971.



FIG. 972.

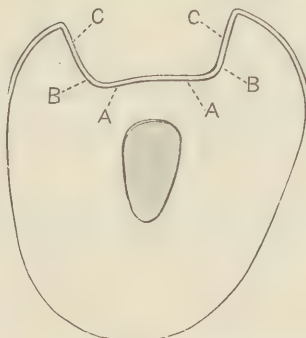


FIG. 973.



FIG. 974.

Fig. 974 represents a typical cavity in the approximal side of an incisor. The dark point, A, in the sectionized portion, represents a

recess in the cavity made necessary by extension of the decay in that direction, which recess must be filled with cement to give proper form to the matrix.

In an approximal cavity sufficient space must be previously secured by some preferred method to permit the matrix, after it has been perfectly conformed to the cavity, to be lifted out without disturbing its form in the least, and also to allow the porcelain inlay to be freely inserted. A method of separation of the teeth to provide room, which is easy for the patient, is to apply moderate force with a separator; pack the space obtained with base-plate gutta-percha to maintain it, and repeat the operation at intervals of a few days until sufficient room is obtained.

In the upper incisors, when a portion of the palatal wall can properly be removed, as shown at A, Fig. 970, less space is required, and removal of the matrix and insertion of the inlay are considerably facilitated.

Direct Method

Formation of Matrices for Low-Fusing Porcelains.—After the cavity is prepared, matrices are made, especially for the Jenkins low-fusing porcelain, preferably of $\frac{1}{2000}$ platinum instead of gold foil No. 30 as originally directed. The foil should be cut round or oval, large enough to cover the walls of the cavity and extend over the adjacent surface of enamel one-fourth of an inch, more or less, according to the location, character and size of the cavity, to permit it to be immovably held in position during its adaptation. The surplus foil, when shaped to the contour of the tooth around the cavity, serves to outline the contour to be given the inlay when the porcelain body is inserted in the matrix.

The platinum foil is first placed in the palm of the hand and the center depressed. The depressed section is next placed in the cavity and the center gently brought down with a pellet of spunk held in a pair of tweezers (Fig. 968), or when necessary by a ball burnisher, as No. 2 of the set illustrated in Fig. 967, and then against the walls. Remove the spunk, see if the adjustment of the foil to the cavity is satisfactory, then replace the spunk, holding it in place with the left hand, by pressing in the center with a ball burnisher. Next, with another piece of spunk held in tweezers in the right hand, bring down the foil over the edges and on the surface of the enamel around the cavity, and burnish it with a burnisher, such as No. 1 or No. 11 in Fig. 967. In the adaptation of the foil to the cavity, and especially for holding it in position in the center while the marginal section is being manipulated,

the author has found that a wisp of cotton, tightly twisted around an old-fashioned, long-handled cavity bur, is very serviceable. The ball-pointed tweezers illustrated in Fig. 968 are recommended for this part of the work. The foil should then be burnished to the sides and margins of the cavity and over the surface of the tooth to impart the greatest possible amount of rigidity to it before its final removal. In a mesial cavity of a superior central the foil appears about as illustrated in Fig. 975, and in a cervical cavity as shown in Fig. 977.

The foil is seldom removed and annealed during its adaptation. A little glycerin may be applied to the surface of the gum, enamel, and cavity to prevent adhesion of the foil. In cases where the cavity closely approaches to or extends under the gum-margin, rigidity will be imparted to the portion of the foil placed there (see Figs. 975 and 977) by folding the edge over before adaptation, as shown at L L, in



FIG. 975.



FIG. 976.

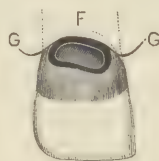


FIG. 977.

FIG. 977.—G G represents line of gum-margin; F, line of foil under the gum.

Fig. 976. The foil when adapted should be so positioned that a slight space will exist between the lap-over edge and the margin of the cavity, about as is also shown in Fig. 975.

Removal of the Matrix.—The removal of a matrix requires most gentle and delicate manipulation, as it must be accomplished without the slightest alteration of the form. On account of its greater rigidity, platinum foil is more easily removed than gold. The cavity usually has one wall inclined slightly more than the others, a conformation which is easily made. The matrix is best loosened at the extreme edge of the burnished surface. The removal of the matrix is much simplified and alteration of its form prevented by filling it with wax. Soften and roll a pellet of hard tough wax a trifle larger than the cavity, place it in the cavity of the matrix when the adaptation is completed, and press it down with a flat burnisher (No. 11, Fig. 967), which should be covered with pulverized soapstone to prevent adhesion of the wax to the instrument. In approximal cavities, the pressure is best exerted with a strip of tape covered with the soapstone. The pressure should be steady and exact. The wax should extend over the edge of the cavity onto the foil, but at no point beyond its margin, as adhesion of

the wax to the tooth will interfere with the removal of the matrix. A stream of cold water from a syringe is next thrown on the wax and the matrix is started and removed from the cavity by the insertion of the point of a fine instrument in the center of the wax. The wax in the case of a platinum matrix can be removed by seizing the edge of the foil with tweezers or a clamp and holding it open end downward for a moment in a cup of water that is simmering, just at the boiling point, or the matrix can be invested in marble-dust and plaster and the wax removed with boiling water.

Should either gold or platinum foil tear slightly in the center of the cavity, it is not a serious matter, as the porcelain body will draw from the edge in the first fusing. Platinum foil has the advantage that it can be adapted to the surface of a tooth under the gum margin more easily than gold.

Investing the Matrix for Low-Fusing Porcelain.—Mix prepared non-shrinkable asbestos investing material with water to the desired consistence and place enough in a small cup or tray to nearly fill it. Paint the under side of the matrix with a little of the material, using a camel's-hair brush, and place the matrix on the center of the investing material in the cup. Vibrate the cup by drawing the side of a serrated instrument against the side or edge of the cup. This vibration will cause the matrix to settle in the investment. See that the investment material covers the exposed edge of the platinum (Fig. 978). Next place the investment in the muffle of the furnace, slowly evaporate the water and burn out the wax in the matrix. Remove the investment from the muffle and when it is cold tip it out of the cup, as in this form it is more easily handled. The matrix is now ready for the application of the porcelain body.

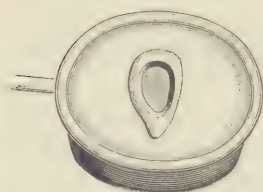


FIG. 978.

Platinum Matrix for High-Fusing Porcelain.—Platinum foil $\frac{1}{1000}$ of an inch in thickness is the gage usually used for the high fusing porcelain matrix. To render the platinum soft enough for the purpose, it should be previously annealed at a white heat in the muffle of a gas furnace, or preferably, on a piece of lime in an electric furnace. Annealed by the latter method it becomes nearly as soft and pliable as gold. A direct gas flame is not suitable, as the desired softness cannot be obtained and the platinum becomes slightly carbonized. The foil is placed across the cavity and cut large enough to extend on each side a little more than if gold were used, so that it can be held securely in position. In a labial cavity, the platinum is allowed to extend over

the surface of the adjoining teeth. If the cavity is on the side or at the incisal edge the foil is brought over on the labial and lingual surfaces. The foil is carefully and gently pressed into the cavity in such manner that it shall not be torn, and the side portions are brought down in position against the surface of the tooth or adjoining teeth. While being firmly held in position, the foil is carefully adapted to the cavity by burnishing. This process is begun at the edge of the cavity with a circular motion of the burnisher around the margins. As the platinum sinks into the cavity, the metal is gradually brought down against the sides and finally in the center. If the metal were first pressed down in the center, as gold foil is, the platinum would be torn to an extent that would ruin it as a matrix. At this stage of the formation of the matrix, if desirable, the foil is removed, annealed, replaced in the cavity and then burnished to the edge and surface of the enamel and removed. Before finally removing the matrix, it is advisable to uniformly compress its entire surface to the walls of the cavity and adjacent surface of the tooth to remove any slight spring or warping should such exist. This is done by introducing into the cavity and placing over the surface of the tooth pieces of spunk and pressing uniformly at the same time on the entire mass. It may be done also by stretching a piece of rubber-dam tightly over the foil. The spunk is first removed and then the foil carefully started at the edges and lifted from the cavity.

To Facilitate the Shaping of a Matrix.—To facilitate the shaping of either a platinum or a gold matrix, place the foil on the surface of a piece of soft fine-grained cork and with a ball-shaped burnisher press the center into the cork and give the foil a cup-shape form approximating that of the cavity. A slit in the foil at about the point A, Fig. 970, but not extending into the cavity, is also suggested but preferably avoided.

Indirect Method

Process of Shaping a Matrix by a Mold or Die.—An impression is taken of the cavity and an amalgam die made. The process of matrix formation for both high- and low-fusing porcelains is the same. The platinum foil is cut round or oval in form, the center depressed in the palm of the hand and then placed in the central or deepest section of the cavity. The center of the foil is first compressed by two or more successively applied pellets of spunk with ball-pointed tweezers (Fig. 968). The spunk is removed and the platinum burnished into all the grooves and depressions, preferably with a round-pointed glass burnisher. The matrix is next filled with pieces of spunk, the spunk

held in position at the edges of the cavity and surface of the form of the tooth. The whole is now placed in a swager, covered with a disk of rubber-dam, and swaged. The spunk is removed from the matrix and the platinum thoroughly burnished with the glass burnisher, the spunk replaced and the matrix again swaged.

Removal of the Matrix.—The spunk is removed and a pellet of hard wax sufficient to fill the cavity of the matrix and extend well over the edge and on the surface nearly to the margins of the platinum, is melted and dropped in. A piece of fine iron wire is hooked on the end, heated and inserted into the center of the wax, the wax chilled, the platinum started at the edges and the matrix lifted from the mold by the aid of the wire. If the matrix is of $\frac{1}{2000}$ platinum, it is invested as already described.

Application of Porcelain Body.—The methods of procedure in applying the body with low- and high-fusing porcelain are quite similar, irrespective of the degree of heat required. A description of the use of one style will practically explain the subject for both.

The Jenkins Low-Fusing Body.—This is a porcelain introduced by the late Dr. N. S. Jenkins, formerly of Dresden, Germany. As indicated by the pyrometer it fuses at 1580° F. It forms a dense, hard porcelain with a considerable degree of crushing strength, and resembles in appearance the porcelain of an English tooth more than that of the American. The following is an explanation of the use of the Jenkins porcelain and the appurtenances connected with it. Place upon a palette the required quantity of the body of the selected color and mix with distilled water. With the small thin blade of the spatula, carry the body, well-moistened, into the matrix and fill it up *to but not over the edges*. During the packing aid the precipitation of the particles of the body by a few light taps on the side of the investment.

Use of Electric Furnace for Baking.—The heat is gradually raised to a point considerably below the fusing point of the porcelain and then increased by degrees, as required. The work being exposed, the process of fusing is seen and determined. With a pyrometer the heat can be accurately defined and the fusing of the porcelain conducted without the expertness required for the purpose without it.

As the Jenkins porcelain fuses at about 1580° F., the primary bakes can be made, guided by the pyrometer, at 1480° to 1500° F., and for the final one the heat can be raised to 1580° F., at which degree it should be held for about ten seconds, when the current should be turned off instantly.

Method of Fusing.—Place the investment containing the matrix on the shelf on the furnace in front of the muffle and slowly evaporate

the moisture. This should not be done hurriedly, as the moisture must be evaporated, *not boiled out*. Next move the investment by degrees into the muffle and gradually increase the heat.

The process of fusing can be clearly seen in the muffle. When the mass begins to fuse, hold the heat but do not try to accelerate the melting by rapidly increasing it. When the work approaches the fusing stage, the fact is indicated by a dark shade which for a moment passes over the porcelain body, caused probably by combustion of a small quantity of gum introduced as an ingredient to assist in holding the particles of the compound together. The body then again assumes a light shade, and at about a red heat fuses sufficiently for a primary biscuit bake, when the application of heat must be stopped instantly. To cool the investment, remove it or shut off the current. When a cup is used to hold the investment, the cooling can be hastened by placing the bottom against the surface of cold water, but care must be taken that water does not enter the cup. In the first fusing the body globulates and contracts nearly one-half of the size of the cavity of the matrix, a characteristic of low-fusing bodies. The fused body in the matrix is moistened with water and more body is applied to fill the vacancy caused by the shrinkage. If the investment is wet with the water in the application, it will not injure it.

For the second bake heat up the investment and body slowly as before to evaporate the moisture and then give the porcelain body another biscuit bake.

A third application of body is necessary for exactness of edges and contour. In the third or final bake, the heat is carried higher than in the previous ones, up to the actual fusing point of the porcelain body, a "glazing heat," to impart a glossy surface. It is well to examine the inlay with a magnifying glass, to be sure that the edges are exact, both in applying the body and after fusing. The tendency on the part of the operator, in the beginning, is to build out too much, but after some experience he learns to get exactly the form and fullness desired. After the final baking it is better to let the piece cool somewhat slowly.

The Application of High-Fusing Porcelain Body.—The application of high-fusing porcelain body to platinum matrices, though similar to that described in relation to low-fusing, differs in important minor details. The shade of body selected is wet with distilled or filtered water and dried with blotting-paper to the consistence of a paste. The matrix may be invested or not. If not invested, it is held by the edge with pliers or clamp-tweezers. (See Fig. 979.) The porcelain body, of a dough-like consistence, is carried on a spatula, or preferably the point of a very small camel's-hair brush, a portion at a time, and

dropped in position in the matrix, and by sharp taps on the back of the tweezers, or by vibrations caused by drawing the corrugations on the handle of the spatula shown in Fig. 960 across them, the body is settled down in the matrix. This tapping or vibrating packs the particles of porcelain closely together and sends the moisture to the surface at each tapping, when it should be absorbed with a piece of blotting-paper trimmed to a point. Through this condensation of the porcelain body, the shrinkage which naturally occurs in the baking is reduced to the minimum, and porosity is avoided. The first application of body should not be allowed to come quite to the edge of the cavity of the matrix. The matrix if not invested is set on a bed of silex on a small fire-clay slab.



FIG. 979.

First Bake.—The slab is placed on the shelf in front of the muffle to evaporate the moisture from the body. It is then slowly advanced into the muffle and the body given the primary bake, which should be, as gaged by the pyrometer, from 150° to 200° F. below the actual fusing-point of the make of porcelain body. Some high-fusing compounds fuse nearly 200° or more above others. The primary bake under such condition must be calculated accordingly, or determined by testing. The heat should be only sufficient to well unite the particles and give the body a slight glaze. In this primary bake considerable shrinkage takes place. The larger the matrix, the more noticeable the shrinkage will be.

Second Bake.—The matrix is again placed in the cavity, and while firmly held in position by pressure exerted on the center of the porcelain, the platinum, which is always slightly drawn from the margins by the contraction of the porcelain, is reburnished at the edges of the cavity. In this second burnishing the platinum, which is then extremely soft from the annealing it received in the baking of the body, is additionally thinned at the margins of the cavity and is adapted with great accuracy. More body is applied, filling the matrix to the edge, and a second bake given at a heat a few degrees higher than the previous one.

Final Bake.—For the final bake all new imperfections in the porcelain are filled in and a heat applied sufficient to perfectly coalesce

the particles and give the work a uniform glazed surface. For this final bake the heat should be run up exactly to the fusing-heat of the porcelain and maintained there for from fifteen to twenty seconds, and then instantly shut off and the work gradually cooled.

Comparative Heat of the Final Bake.—Should the circumstances require more than two primary bakes, the full fusing-heat of the porcelain should be avoided until the final one.

Removal of a Foil Matrix.—When the inlay is cool, always first wet it with water before handling, then, if invested, remove it from its investment. With tweezers gently and slowly bend back the foil from the edges and it will usually strip off in one piece. If any shreds of foil adhere to the inlay, remove them with a fine excavator.

Preparation for Cementation.—For the purpose of retention of inlays, a few grooves are made on the bottom and sides of the porcelain with a small diamond disk (see Fig. 98o), or the gloss removed with a very small cone-shape carborundum point to facilitate adhesion of the cement.

Methods of Etching with Acid or a Diamond.—If the inlay is too small to handle conveniently, the gloss can be removed by covering the face and margins of the base with wax and applying hydrofluoric acid for a few minutes. An inlay can be quickly etched over the entire surface except along a line at the extreme edge where it meets the margin of the cavity, with a diamond point in the engine hand-piece, aided by a lens to magnify the part. The lens, for convenience, should be mounted on a stand like that used by wood engravers. By this method nearly the entire cavity-surface of the porcelain is divested of its glaze and roughened. The adhesion of the cement to such a surface, which is much more porous than when merely acted on by hydrofluoric acid, is absolute, and displacement of the inlay from lack of attachment of the cement is well assured against. Excessive and deep indentation of an inlay with disks weakens it and renders it liable to fracture in insertion or use. In shallow inlays it is liable also to affect the shade.



FIG. 981.

To Aid Adjustment in Cementation.—In the cementation of an inlay it is well to be able instantly to insert it correctly in the cavity, as its removal and reinsertion after the cement is applied are objectionable. The inlay after the fitting is completed may be laid upon the operating case in such wise that there will be no uncertainty in carrying it straight to its correct position. Another way is to insert the inlay before the cement is applied, and after drying the sur-



FIG. 980.

faces mark corresponding parts of tooth and inlay with a fine-pointed pen, drying the ink with hot air. (See Fig. 981). The marks form an unerring guide to the proper relative position of the inlay. A few grooves may be made in the walls of the cavity to favor the cement, but this is not always considered necessary.

Cementation

Requirements: Effect on Color of Porcelain.—Oxyphosphate cement is almost universally used for the cementation of porcelain inlays. Its adhesiveness to both tooth-structure and unglazed porcelain renders it most suitable for the purpose, but its solubility at the edges of an inlay is what chiefly raises the question of durability of this class of operations. The durability of porcelain inlay-work depends on the *closeness of the meeting edges of inlays with those of the enamel at every point*. The opaqueness of this cement, owing to the translucency of the porcelain, frequently very materially affects the shade of a cemented inlay. The effect of the cement on the shade can be quite accurately determined previously by first mixing a little of the powder of the cement with water, placing it in the cavity, and inserting the inlay. The shade of the cement should accord well with that of the inlay or tooth, but be a trifle lighter.

Operation of Cementation.—Successful cementation of inlays largely depends on the manner in which the oxyphosphate is used, as well as on its quality. The cement should be most thoroughly mixed, and its consistence should be as nearly that of a thin paste as possible without too great an impairment of its adhesiveness. A cream-like consistence, such as is used for gold cap-crowns, is not reliable. A cement which can be mixed moderately thick and still retain its adhesiveness, and yet in that condition easily ooze out from under and around an inlay at the edges under properly exerted pressure, is the most suitable. As the action of phosphoric acid on the ordinary steel spatula affects the color of the cement, an ivory or agate spatula is the most suitable to use for the purpose of mixing the cement.

Silicate cement is now to some extent being used to cement porcelain inlays as more translucent and less soluble at the edges.

The inlay and cavity having been dried perfectly, a little of the cement is smeared in every part of the cavity and on the sides and bottom of the inlay, and especially in any groove present. The cement is then placed on the inlay and the inlay inserted in the cavity and gradually pressed home. Before it is quite in place, the surplus cement should be quickly removed from the surface, the inlay carefully

examined to see if it is exactly in correct position, and the final pressure given with a properly shaped piece of wood. The final pressure should be gentle and elastic, and exerted on the center of the inlay, until all surplus cement has oozed out. In approximal cavities a piece of tape or floss silk may be used to press an inlay to place, but a wedge-shaped piece of wood is to be preferred. If the rubber-dam is used, leave it on until the cement has set. Varnish should be painted over the inlay. In an hour or at a subsequent sitting, particles of cement which may still be clinging to the tooth or inlay should be removed. If on examination the porcelain should be found to improperly project beyond the surface of the enamel at any point, it should be reduced with finishing disks or strips, or Arkansas stone points.

CHAPTER VII

SPECIAL OPERATIONS

Large Contour Inlays.—When considerable contour is given or a corner is built out, for instance, in a case such as is represented in Fig. 982 and others of that character, the porcelain should always be set at a right angle to the biting or incisal edge of the tooth under treatment, as shown at A, or chipping is liable to occur. In this and all such cases a projecting horn of the porcelain (B) will make a much stronger anchorage than a platinum pin. A platinum pin in a small mass of porcelain has a tendency to weaken it by breaking up the continuity of its structure.

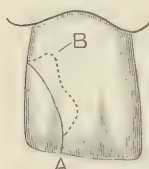


FIG. 982.

Use of Pieces of Porcelain Teeth.—In building up corners of large contours a piece of a porcelain tooth of the exact shade can be placed in the matrix, and the body built around and over it. The applied piece of fused porcelain by its presence lessens the usual proportion of shrinkage of the inlay in baking and simplifies the construction of a sharp corner. In the use of the high-fusing porcelain, after it has been baked in position in the matrix, the work may be adjusted in the tooth, its position examined, and, should any point of the piece of porcelain project excessively, it can be trimmed off with a carborundum wheel. The porcelain should then be washed and cleaned of the *dibris* resulting from the grinding.

Use of Successive Grades of Bodies.—The use of successive grades of high-fusing porcelain, commencing with a very high-fusing foundation, and followed by lower and still lower-fusing bodies, often simplifies the operation of building out a difficult corner. In such a case each application should be biscuited and fused before the next lower-fusing grade is added.

Occlusion in Close Bite.—When a large corner is built on an upper incisor, if the bite is close, the porcelain should be depressed at the point of occlusion with the lower teeth, and enough of the incisal edge of the lower antagonizing tooth should be ground off to leave a slight space—say that of thin cardboard—between.

Porcelain Inlays in Combination with Gold or Amalgam Fillings.

In a case of combined approximal and cervical decay, where the shape is unfavorable to the formation of an entire porcelain inlay, or undesirable, fill the approximal cavity with cohesive gold, extending it into the cervical cavity, trim the edge of the gold, and then form and insert the inlay partly in the latter, as illustrated in Fig. 983.



FIG. 983.

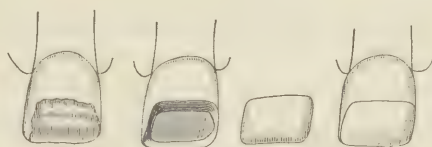


FIG. 984.

Large amalgam fillings, especially in either the bicuspid or molars, may be treated in a similar manner.¹

Atrophy and Erosion.—In atrophy of the enamel, as illustrated in Fig. 984, porcelain inlay-work is specially suitable. In cases of erosion, where shrinkage of the gum causes exposure of a portion of the root, as shown in Fig. 985, the section of the inlay over the root can be enameled with gum-colored porcelain. Gum enamel fuses at a lower heat than the porcelain it accompanies, and is to be applied after the final baking of the inlay, but before removal from the matrix.



FIG. 985.

Porcelain Tips.—From an esthetic standpoint porcelain is the most suitable material to use in the repair of fractured front teeth or in cases of atrophy. The construction of the porcelain tips for such cases is one of the most difficult operations to perform acceptably and reliably.

¹ The silicate cements are now largely used for this purpose.

The application of porcelain tips is limited. Small pieces of porcelain will not withstand the force of mastication, as in cases of mechanical abrasion and in some forms of fractures reliable anchorage in teeth with vital pulps is either difficult or impossible to obtain.

Fig. 986 illustrates a case of atrophy in which the tips of the central incisors were contoured with porcelain. The right central shows the porcelain in position, the left the porcelain tip ready to be adjusted. A dovetailed cavity was first formed in the central portion of the section to be tipped or contoured. A piece of platinum foil was adapted to the cavity, and high-fusing porcelain body baked thereon as already described. The platinum foil was then removed and the tip cemented in position.

To form an extremely strong porcelain tip, select a porcelain tooth of the correct shade, pulverize finely the portion corresponding to the part to be restored, and use the powder as the body to form the

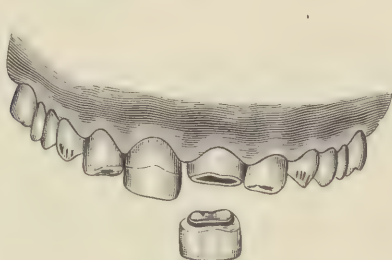


FIG. 986.



FIG. 987.

tip. A very high heat is required to fuse the porcelain of artificial teeth, but the greatest possible strength in a porcelain tip is secured by the use of such a body.

Porcelain Shoulders Preferable to Pins for Retention.—For the retention of a porcelain tip, a shoulder of the porcelain, such as is illustrated in Fig. 986 is preferable to forming the tip with a loop of wire or with platinum pins, which are to be cemented in holes drilled in the tooth-substance. The presence of pins, as before mentioned in regard to other operations, weakens so small a piece of porcelain by breaking up the continuity of its structure. The pins do not form for it as secure or strong an attachment as a porcelain anchorage of moderate size.

Wire Loop.—In cases of fracture in which porcelain tips are required, and the existing conditions do not permit of the removal of sufficient tooth-structure to form a porcelain anchorage, the use of pins must be resorted to. In such a case, after the holes have been formed,—there

should not be more than two,—and the parts properly prepared, the surface of the fractured part is capped with platinum foil punctured over the holes and the pins inserted. The wire to form the pins should be of about gage No. 21. It should be first rolled under a fine flat file to slightly roughen its surface. The pins should extend from the foil, or the wire forming them be shaped in a loop, as shown in Fig. 987. While the platinum cap and pins are in position on the tooth, a small quantity of a very high-fusing porcelain or foundation body is applied to the center of the cap and closely around the pins. The excess of moisture is absorbed with blotting-paper and the surplus body removed with a small brush from around the margins of the cap. The wire or loop is then seized and the whole gently removed from the mouth and given a biscuit bake. On removal it is readjusted on the tooth. The shrinkage of the foundation body is compensated for by the addition of more body, and it is again inserted in the furnace and then given a bake at the fusing-heat of the porcelain. If the extension of the loop of wire above and across the surface of the cap occupies more space than the size and form of the part to be restored will allow, the loop should be bent down a little against the surface of the cap or be partly or entirely removed by grinding, leaving only the pins. Should the latter course be necessary, the pins will then be held in position by the foundation body which has been fused around them. The cap is next placed on the tooth and the margins of the platinum burnished closely around that of the fracture and the formation of the tip completed with porcelain body which fuses at a lower heat than that already used. After the final fusing of the porcelain the foil is torn from the base. It will not adhere to the pins, not having been soldered to them. The burnishing of the foil at the margins of the cap after the first baking slightly reduces its gage in comparison with the central portion and tends to effect a closer fit for the porcelain at that part. Another method is to first cement the ends of the wire loop into the holes in the dentin, and form the tip with a cavity for the loop to fit and to be cemented into.

Small Fractures.—Fractures of the incisal edges of the incisors, of the character and as small as those illustrated in Fig. 988, cannot be restored with porcelain. The fractured part usually consists entirely of enamel, and the area to be operated on is so small that a reliable anchorage in the porcelain is not obtainable. If the form and length of the teeth will permit, the defect is best remedied by trimming the incisal edge of the adjoining teeth and the fractured tooth to correspond in length, then smooth and polish. When an incisal fracture is too large to correct the appearance by trimming and the pulp is vital,

a three-pin plate or inlay can be applied to the lingual side and the incisal edge restored in gold with a space at the labial side to receive and retain synthetic cement (see page 549).

When an imperfection of the enamel, decay, or a fracture involves only the central section of a moderately thick incisal edge of an incisor or cuspid, that part may be inlaid with porcelain by shaping the cavity as illustrated in Fig. 989.

In cases where the fracture or imperfection involves a loss of nearly one-half of the natural crown, an artificial crown is preferable.



FIG. 988.



FIG. 989.

Rod Inlays

The use of rod inlays on the labial surfaces of the superior incisor teeth is especially adapted to inlays too small to be formed by fusing porcelain in a foil matrix of the cavity, or in circular cavities or in cavities which properly can be shaped round.

Preparation of the Cavity.—The cavity to be inlaid is shaped with a fine-cut wheel-bur of the style shown in Fig. 990, perfectly round, with straight walls, over one-thirty-second and approximating one-sixteenth of an inch in depth. As an inlay of this style cannot very well be manipulated of a diameter less than No. 20 gage, the cavity requires to be enlarged to at least that size.

The Rod Inlay.—The inlay is made from a portion of one of the porcelain rods (Fig. 991) or circular pieces of porcelain (Fig. 992) manufactured for the purpose. The porcelain is mounted with shellac on either end of one of the mandrels as shown in Fig. 993, and gradually ground down in the handpiece of the dental engine to fit the cavity, using a flat piece of carborundum, and fine sand or emery paper in the final reduction. A micrometer gage is an aid in measuring the size of the bur to be used and the diameter of the inlay during the reduction and fitting.

Cementation and Finishing.—The inlay when fitted is detached from the mandrel, the cavity very slightly undercut, and the inlay, without being ground or notched, cemented with oxyphosphate, which will adhere tenaciously to the surface of the ground porcelain.

When the cement has set perfectly, the porcelain which protrudes above the surface of the enamel is ground level with small carborundum points



FIG. 990.

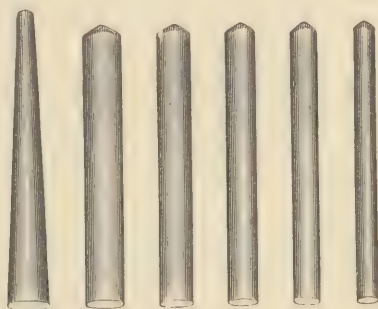


FIG. 991.

or wheels and finished with Arkansas stone points. Figs. 994 and 995 show inlays that are best inserted by this method where imperfections or cavities exist.



FIG. 992.

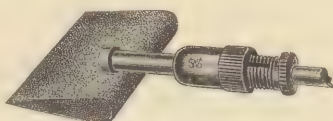


FIG. 993.



FIG. 994. FIG. 995.

Points to Bear in Mind

To Facilitate Matrix Adaptation.—In the adaptation of a matrix in an approximal cavity the process is greatly simplified by the presence of abundant space and freedom from interference by the gum-septa. In cases where cervical decay extends under the gum-margin, the cavity should be previously packed with cotton or gutta-percha, and the gum pressed from normal position sufficiently to fully expose the edge of the cavity and permit perfect adaptation of the matrix or taking an impression. In the direct method packing the cavity of the matrix with wax, in such a case, is to be recommended, especially if $\frac{1}{2000}$ platinum or gold foil is used, as the wax will maintain the position of the foil should any point press against the gum.

Tray to Bake on.—The use of fire-clay trays is recommended in preference to the metallic for the reason, in the opinion of the author, that a short circuit is frequently formed in a muffle in moving a metal-

lic tray over its surface by touching some slightly exposed part of a wire.

To Overcome Contraction of Body.—In the use of any grade of porcelain body the most extensive shrinkage occurs in the first baking. The body contracts from the sides toward the center. To cause the contraction to take place from the center toward the sides it has been suggested to place the body in a ring around the sides of the matrix; this, however, is seldom practical. Instead, a little of the body may be removed from the center of the filled matrix. When an inlay is large enough to permit it, the effect of shrinkage is controlled to a considerable extent by serrating the body, thus dividing it into several small sections.

To Aid Removal, and Remedy a Tear in a Matrix.—The removal of a matrix from a cavity is often facilitated and the presence of a large tear in the bottom overcome by filling the matrix with the porcelain body, on the same principle that wax is often applied, before removing it from the cavity. The body is placed in the cavity and compressed with a strip of tape or pellet of cotton to condense it and absorb the moisture. The surplus is then brushed off with a camel's-hair brush, and the matrix removed and baked. In the use of high-fusing porcelain in such cases a foundation body had best be applied, especially when the matrix is torn.

Advantages of the Use of a Foundation Body in Contour Operations. In contour operations it is advisable to use a foundation or basal body in the first baking, as it fuses at a higher heat than the body used to construct the remaining portion. The use of a basal body is advisable, especially in a case where the bottom of the platinum matrix is cracked or broken. In the first baking it covers over the breaks and remains intact during the application of the remainder of the lower-fusing porcelain which is applied to shape or build up the inlay, and gives form and rigidity to the base. As a basal body fuses at a higher heat than that subsequently applied, it should be both "biscuited" and thoroughly fused before the application of the additional lower-fusing body.

The Use of a Lens.—The use of a 3-inch lens magnifying about two diameters, mounted on a stand so that the work can be held under it and viewed at pleasure, will prove of great assistance, especially in the manipulation of the porcelain body in the matrix.

Small camel's-hair artist's brushes will be found very serviceable for brushing and removing particles of the porcelain body around the edge of the matrix, and at times adjusting small portions of it in proper position.

Porosity of Porcelain.—Porosity of porcelain is attributable to imperfect packing, gassing, heating too quickly, or overheating. Brittleness will result from the same causes and from cooling too rapidly. The Indirect Method permits the entire operation to be performed in the laboratory and any failures are corrected without any delay to, and without the knowledge of the patient.

Edges of Inlays.—In all inlays it is preferable to have the edges a little too low rather than too high. If the porcelain is too high it can be ground down and still give good results, but the original gloss is to be preferred.

Small Inlays.—Good edges are difficult to obtain in porcelain inlays smaller than a pin-head when made in a matrix. In such cases the use of the porcelain rod method is preferable.

Effect of Cement on Shade.—In small labial inlays, unless the cavities are deep, the cement will show through the porcelain in such wise as to mar the intended effect.

Requirements in Inlay-work.—An inlay should fit the cavity so that the edges shall be absolutely exact and not perceptible. It should not rock or move when inserted in position, and the occlusion should be correct. Slight rocking of an inlay when the fusing is completed and it is fitted in the cavity is often occasioned by a rent which existed in the bottom of the matrix, causing an unevenness at that part. This may be effectually corrected by trimming the part.

Conservative Limitations of Porcelain Inlay-work.—Porcelain inlays, in the opinion of the author, should be limited to that class of operations where the question of the exposure of a metallic filling to be avoided is viewed from an esthetic rather than from a practical standpoint. The advantages and durability of gold and amalgam fillings as tooth-savers have been too long and too well established to properly permit of their supersedure by a cemented inlay formed of an unyielding material like porcelain, except where the question of esthetics is a factor. If around the entire circumference of a porcelain inlay when cemented in the cavity there exists a single point where the adaptation is imperfect, that point is vulnerable with even the best cements so far offered to the profession. A corresponding imperfection in a gold inlay, if formed according to most recent methods, can usually be remedied by the burnishing given its feather edge against the margins of the cavity before and after cementation in the final finishing of the inlay.

CHAPTER VIII

PORCELAIN CROWN-WORK

Structural Requirements.—In porcelain and platinum work, the metallic structure constitutes the foundation and the porcelain the part to be restored. The metallic part consequently should be made strong and rigid and of a character that will furnish the best possible support and attachment for the porcelain. The line of union or joints of the sections composing the metallic part should be closely fitted so as to insure perfect contact. Pure gold is used ordinarily as a solder to unite the parts. Gold alloyed with the baser metals is unsuitable, as their presence would stain the porcelain. Only the smallest possible quantity of the gold that will effect the object should be used, as subsequently in the baking of the porcelain it is entirely absorbed by the platinum. Small spaces are thus liable to be created under the porcelain at points which tend to weaken the structure of the crown. In the absorption of the gold, the sections of the metal which touch where it was applied become sweated together in such manner that they will not be separated by any degree of heat subsequently applied. This absorption of the gold solder consequently may, in a measure, be effected at the time of soldering by applying sufficient heat. This is allowable in soldering invested sections of the metal alone, but when porcelain is included the intense heat is liable to cause etching of the porcelain from its contact with the investing materials. Etching may, in a measure, be avoided by varnishing the surface of the teeth with shellac previous to investment.

Platinum Solder.—Platinum solder, 25 per cent. platinum to 75 per cent. gold (see page 12), is recommended in preference to pure gold, as it is not absorbed in the baking of the porcelain, and strengthens as well as unites the parts. The compound oxyhydrogen blowpipe flame is required to fuse platinum solder, the use of which is described, page 41.

Nature of Adhesion of Porcelain Fused on Platinum.—Porcelain body fused on platinum adheres to the surface, but the adhesion is only mechanical. Consequently, should any change occur in the form of the metallic base, the porcelain is liable to become detached. This fact should be kept in mind regarding this class of operations. The surface of the metal that is to receive the porcelain should be roughened or serrated with a sharp-pointed instrument, at parts that suggest it, and where it is permissible, either indented or punctured.

Submitting the surface of the platinum to the action of aqua-regia, also sprinkling coarse platinum filings on the surface of a section of the metal and attaching them with an atom of pure gold, furnishes a means of secure adhesion for porcelain body. By simply scratching the surface of the platinum quite a reliable attachment of the porcelain to the metal is obtained, as is demonstrated in the construction of artificial plates of porcelain on platinum—the form termed continuous-gum work.

Application of Porcelain Body in Crown-work.—The metallic structural frame-work of the crown should be thoroughly cleansed of



FIG. 996.

borax with acid and washed free of all particles of foreign matter. Any sharp edges or points that are liable to be exposed in the finished crown are to be rounded and smoothed. The method of selecting shades and applying porcelain body in crown-work is similar in principle to that explained respecting high-fusing body used in inlay-work. The porcelain body should be placed on a clean glass or porcelain slab and mixed with pure water to a dough-like consistence. The addition of a small quantity of dissolved gum tragacanth is to agglutinate the particles

of the body in difficult contour-work.¹ The crown is held by the post in a pin-vise, as shown in Fig. 996, during the application of the body. By tapping the handle of the vise with the mixing spatula as the body is applied it is packed into the interstices of the work and the moisture is brought to the surface, to be absorbed with blotting or bibulous paper. More body is then gradually added until it assumes the general form and proportions desired in the finished crown. As the proportion of shrinkage that takes place in the first bake approximates one-third the bulk, calculations should be made accordingly. The work is then ready to receive the first fusing.

Baking.—The baking of porcelain body in crown-work is conducted similar to that described for porcelain inlays in Chapter VI. The first bake should be the “biscuit bake,” effected with a heat which will cause the body to shrink and become hard but not glazed, though the mass is covered with shining particles. If the work is allowed to remain in the furnace for the first baking until the fusing-point is reached, porosity and imperfections are liable to appear in the final application and fusing. After the crown has received the biscuit bake it may be adjusted in the mouth or on the articulating model and the porcelain ground off or added to where necessary for proper occlusion and approximal contact.

For the second bake the seams and crevices are filled and the body added until the parts are slightly larger than is required. As in the previous application of body, all the moisture possible should be brought to the surface and absorbed. The less moisture allowed to remain and the greater the condensation of the particles each time, the less the shrinkage which will take place.

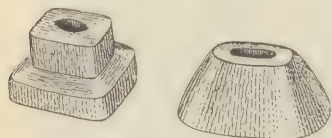


FIG. 997.

For the third or final fusing, after the necessary addition of body is made, the crown is slowly heated in the furnace and allowed to remain until the surface of the body assumes a smooth, glazed appearance corresponding to that of natural enamel.

After the final baking, the crown should be allowed to cool very slowly to temper the porcelain. Too rapid cooling will injure the crown-work, if not destroy it. If an electric furnace is used, the current can be turned off and the work allowed to remain until cool; or it

¹ Dr. F. T. Van Woert's formula is:

Gum Tragacanth.....	$\frac{1}{8}$ oz.
Alcohol.....	$\frac{1}{2}$ oz.
Water.....	$\frac{1}{2}$ oz.

Dissolve the gum in the alcohol and then add the water, stirring rapidly.

can be removed and placed in a muffle provided for cooling purposes. When cool, the crown should be dipped in water before handling.

Fig. 997 illustrates forms of fire-clay supports on which a crown can be placed during the fusing of the porcelain.

Degrees of Heat.—In crown-work the heat as registered by the pyrometer for the first bake should be 200° below the fusing-point of the porcelain body used; that of the second, or other primary bakes, 150° , and of the final bake the fusing-point, at which degree the crown should be kept for twenty seconds.

Porcelain and Platinum Collar or Partial Collar Crowns

Process of Construction of Collar Crown.—The collar should be made of platinum, about gage No. 29 to 30, or iridio-platinum, gage 31 to 32, and the piece which caps the collar of platinum plate about No. 32. The collar or partial collar-cap is first constructed and fitted to the end of the root as illustrated in Fig. 998, according to one of the methods described at page 210. The post should be substantial, and in all cases be extended some distance above the surface of the cap as an attachment for the porcelain. It should be closely fitted to the cap at the orifice of the canal by perforating the platinum and forcing it to position, and then united to the cap with pure gold or, better, platinum solder. A suitable cross-pin tooth is selected, and ground and fitted on the cap; a shade slightly darker than the corresponding natural tooth is to be preferred, as the color is generally lightened in the baking. Usually in the case of incisors and cuspids it will be necessary to reduce the dimensions of the post to permit it to pass between the pins, and in many cases also to grind a groove in the porcelain facing for its reception. This is necessary to allow the tooth to assume the proper position on the cap, as the bases of most porcelain facings will be found when fitted to hang over the space occupied by the post in the root-canal. The pins should be bent around the post in such manner as to retain the facing in position during the application and baking of the porcelain; or, the crown should be invested and the pins soldered to the post with pure gold, which is generally the better method to pursue.



FIG. 998.

Both post end and pins should entirely clear the occlusion of the antagonizing teeth.

The crown when soldered is boiled in acid to remove the flux, and having been fitted on the model or in the mouth to determine the accuracy of the parts and then thoroughly cleansed, is ready

for the application of the porcelain body. The body for a crown of this kind should be nearly as high-fusing as that of the porcelain facing so as to afford the required strength.

In cases where the porcelain facing projects, as shown in gold crown-work in Fig. 304, the part can be filled with porcelain. Should the cervico-labial section of a collar be exposed to view, a little of the porcelain may be extended onto the collar at that point so as to hide the metal, but it should be graduated off at the sides toward the approximal spaces.

Partial Collar-cap.—When a partial collar-cap is used, should the cervico-labial margin of the porcelain facing extend perceptibly beyond the line of the edge of the cap, the projecting portion of the porcelain should be trimmed and re-enameled in the baking.



FIG. 999.



FIG. 1000.



FIG. 1001.

Bicuspid and Molars.—Bicuspid and molar crowns can be constructed in a similar manner by using a suitable facing on the cap, and building up the occluding surface and cusps with the body. A small additional post or bar, to securely attach and support the palatal cusps, may be added and soldered to the cap, as shown in the case of a bicuspid in Figs. 999, 1000 and 1001.

Practical Method to Form Occlusal Section.—The length of the palatal section of the crown and form of the cusps are quickly and accurately determined by placing the porcelain body—preferably of the first bake or both first and second bakes, foundation body—of a dough-like consistence, in a mass in position on the cap, packed against the facing, inserting in the mouth or on the model, occluding the teeth on the body, and removing. The occluding teeth in leaving their impression on the body, shape and outline the form the occluding surface of the crown should be. The porcelain body is then trimmed and properly shaped in accordance with the form of a natural crown, Fig. 1002, and then given the biscuit bake. Long cusps should be avoided. More body is again applied, guided by the occluding teeth, to compensate for the shrinkage, and the usual bakes given. When a foundation

body is used, it should be thoroughly fused to develop its greatest strength before the application of a lower fusing body. If the glazed surface should cause the dry particles to flake off, dull it with a carborundum point. A, Fig. 1003, shows the appearance of the crown after the first, and B after the final bake.



FIG. 1002.

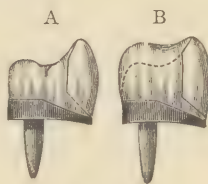


FIG. 1003.

Crown without a Collar.—A porcelain and platinum crown without a collar is made by fitting into the root a substantial iridio-platinum post, and capping the root with a disk of platinum. A porcelain detached-post crown is then fitted over the end of the post and attached with porcelain. The disk of platinum should be about gage No. 32, unless it is to be removed after the crown is baked, in which case it should be made about gage No. 40 or thinner.

Limitations.—Porcelain and platinum crowns of the forms above described for either the anterior or posterior teeth are not suitable for a close occlusion, or, as ordinarily termed a “close bite,” as fracture of the porcelain is sooner or later quite certain to occur. Porcelain and gold construction in such cases should be given the preference.

Platinum and Porcelain Jacket Crown

This crown consists of a cone-shaped combined platinum and porcelain cap fitted like a jacket over a natural tooth, with or without a pulp. It presents good qualities of many of the best forms but not the strength. It is especially suitable in the crowning of pitted and malformed peg-shaped teeth and cases of erosion, as it permits the formation of a crown without the exposure of metal at the labial aspect and in most cases without removal of the pulp.

It requires the least possible removal of tooth-structure to permit the mounting of the crown. Its natural appearance admits of the performance of operations of a most artistic character.

When the construction is so conducted that the incisal edge is protected with metal, it forms a crown which for strength approaches that of porcelain and gold.

In pulpless teeth a post cemented in the root independent of the crown much simplifies any required reconstruction of the form of the natural crown.

Incisors and Cuspids with Platinum Jacket.—The crowning of a central incisor will serve as a typical case. Fig. 1004 represents the shape of the prepared tooth with a vital pulp. If the crown is broken off or decayed to the gingival margin, a post is inserted in the root and shaped with cast gold or amalgam to a somewhat conical form. A collar of platinum (gage No. 31) the full length the crown is to be, is made and fitted to the prepared tooth or root. The use of an amalgam die made from an impression taken in a tube with impression compound will facilitate this part of the operation.



FIG. 1004.

The lines of the lingual and labial surfaces of the adjoining teeth are marked on the platinum. The palatal portion of the collar is cut away to this line, so as to clear the lower teeth in occlusion (Fig. 1005). A piece of platinum, of the same gage, is soldered over the collar, to form the palatal wall. The cap is fitted in the mouth, and the labial section of the collar ground thin enough to enable the platinum to be pressed and burnished against the tooth or the built-up amalgam. If this cannot be done satisfactorily, trim off the platinum the same as on the palatal side and solder a piece of platinum foil over the part instead. It must be remembered that in this soldering only the least possible quantity of pure gold should be used. At this stage the cap will assume the form seen at Fig. 1006.

Application of the Porcelain Veneer.—In this style of crown-work teeth having living pulps afford so limited a space for the porcelain facing as not to permit the use of one with pins for its retention on the cap during the application of the porcelain body. Facings can be made of the porcelain body alone for a molar or second bicuspid, but the results respecting appearance would be unsatisfactory for the anterior teeth. Veneers formed from artificial teeth are preferably used for this class of work as a rule.



FIG. 1005.



FIG. 1006.

Pulpless teeth, and in some cases those with calcification of the pulp, will stand the removal of sufficient of the natural crown to allow of the formation of a cap which will permit the use of a facing with pins that can be soldered to it.

A thin veneer of porcelain to represent the tooth is made by selecting an ordinary porcelain tooth of the proper size and shade, removing the

pins and grinding it down as described in Part I, Chapter III, Fig. 4, and illustrated at A, Fig. 1006. The veneer is ground and fitted to assume a proper position on the cap. Porcelain body is then applied and the veneer pressed to place, surplus moisture absorbed, and particles of body removed. It is possible to fit the veneer held by the body on the cap in the mouth when desirable. The cap and veneer are removed and placed on silex on a slab, with the face of the veneer resting downward on the silex to retain it in position, and the whole is then placed, baked, and the body biscuited. Another method is to gently remove the veneer from the cap, disturbing the body as little as possible, and insert the cap without the veneer in the furnace. When the cap is baked the veneer will be found to fit in the indentation in the body. In this way the excessive shrinkage of the first baking and the consequent slight displacement of the veneer are overcome. For the second baking the veneer is then placed on the cap with the necessary body to attach it and slowly heated and baked. The body should be placed over and on the incisal edge of the cap and around on the sides as far as permissible to secure the greatest amount of attachment for the porcelain.

After both the first and second bakes the work should be fitted in the mouth and any of the changes incident to shrinkage of the porcelain body noted and corrected. Any necessary slight alteration respecting the position or size of the veneer and the fused applied porcelain body should also be made at these stages of the construction so that the porcelain may be enameled in the final bake, which should be most carefully conducted in regard to heating and cooling. After the final bake the exposed surface of the platinum should be polished. Crowns of this style can be well cemented only with oxyphosphate. Fig. 1007 represents the finished crown.

Protection of the Incisal Edge.—To protect the incisal edge of a crown of this style the palatal side of the collar is made of iridio-platinum plate instead of platinum, of about No. 30 gage or heavier, as the character of the occlusion suggests. The end of the strip is brought over the incisal edge in a manner to protect the porcelain in occlusion, as shown at P in Fig. 1008,¹ the same as in porcelain and gold work. In cases of jacket-crowns where the space will permit, a porcelain facing with pins may be used and the pins soldered to the cap, as shown in Fig. 1009.

Porcelain and Platinum Bicuspid Cap-Crown with Porcelain Occlusal Surface.—When the natural tooth is broken down and pulpless, the following method can be practiced: A platinum collar is made

¹ Dr. W. A. Capon's method.

and fitted, with the labial section prepared and a veneer adjusted in the same manner as in the method just explained. The edge of the collar should clear the occluding teeth about one-thirty-second of an inch. (See Fig. 1010.) While the collar is in position, a layer of platinum foil is packed in, over, and around the end of the root or any part of the natural tooth present (A). Porcelain body is then packed in on the platinum foil, the space being filled even with the edge of the collar. The veneer is placed in position against the porcelain body and



FIG. 1007.



FIG. 1008.



FIG. 1009.

the body packed around it. The crown is then carefully removed and baked. After baking it is placed in the mouth, the occlusion noted, the cusps properly shaped with body by occluding the teeth on the applied body, and the final fusing of the porcelain performed. Fig. 1011 illustrates the completed bicuspid crown. Fig. 1012 shows a molar constructed by this method. The construction of this crown may be varied by soldering the foil, or a very thin piece of platinum plate placed inside the collar, to its sides, using a porcelain facing instead of a



FIG. 1010.



FIG. 1011.



FIG. 1012.

veneer, and soldering the pins to the foil or thin plate. The porcelain forming the occlusal section being encompassed by the metal, develops great strength. It is a form of crown that admits of extensive application.

A Porcelain and Platinum Bicuspid Crown with Metal Occlusal Surface.—This form is applicable to teeth with vital pulps as well as pulpless. The method is as follows: The tooth or root is prepared

the same as for an all-gold crown and enough of the labial section removed to allow for the veneer (Fig. 1013). If badly broken down it should be built up with a post and amalgam. A collar of platinum is made and fitted the same as for an all-gold crown, and trimmed free of the occluding teeth. A suitable occlusal surface is made by stamping up a piece of annealed iridio-platinum plate, No. 30 gage, or heavier, if the case should suggest it for strength. The lingual half is soldered to the collar, but the buccal portion is left unsoldered and free (Fig. 1014), to permit the front portion of the collar to be manipulated. The buccal section of the collar is next ground thin and pressed inward against the



FIG. 1013.



FIG. 1014.



FIG. 1015.

tooth, to make room for the porcelain veneer. It will then appear with the occlusal surface as shown at Fig. 1015. Puncture the thin platinum over the labial surface, and select and fit a porcelain veneer to represent the tooth. Pack in porcelain body and fit the veneer in position in the mouth. Carefully remove and bake in the furnace. Next refit in the mouth, make any necessary changes, add more body, and give the final baking. The platinum is then polished, after which the crown is ready to be cemented. Fig. 1016 represents the finished crown.

The form of crown just described can be used in bicuspid in all cases, more especially where there is a close occlusion. In bridge-work, a porcelain-faced pontic backed with gold can be soldered to this form of crown to represent a first bicuspid, the precaution being taken to heat and cool the investment slowly.



FIG. 1016.

Porcelain and Platinum Tube Crown.—This crown is for use in cases where the natural crown is absent to the line of the cervix and a metallic collar is not used.

The root is ground even with the margin of the gum. An iridio-platinum post is fitted and cemented in the root, as seen in section in Fig. 1017, and, if an excessive enlargement of the root-canal exists, amalgam is packed in the orifice of the canal around the post or a gold cast post is used. In the case of a broken artificial crown where the post.

remains with its end protruding from the root, the tube is to be shaped to fit over the post. Take a piece of wire, of the gage of the post, and twist platinum foil around it so that the foil shall form a tube. Slip the tube on the post in the root. Cut a disk of platinum foil fully the size of the end of the root, puncture it in the center, and slip it over the tube on the post. Draw off the tube and disk carefully, and solder

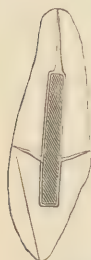


FIG. 1017.

them together with the smallest possible quantity of pure gold. This forms a combined tube and cap. Adjust in the mouth and burnish the platinum disk closely to the root. Pack porcelain body in a thick paste around the tube and fit a veneer (as shown in Fig. 1006) in proper position against the body, remove, and bake.

If a porcelain facing having pins can be fitted and used, the pins may be soldered to the tube with a little pure gold to retain it in correct position before the application of the porcelain body; if not, the use of a veneer may be resorted to, the same as in the preceding cases. After baking, place the crown in position, burnish the platinum thoroughly at the gum line, and trim off the excess. Add body where required and give the final baking. It is optional whether the platinum be allowed to remain on the base of the crown or not, but the portion at the cervico-labial section is generally removed for the sake of appearance. Fig. 1017 shows the finished crown in section. Should this crown fracture in use, it can be replaced without disturbing the post in the root.

Application to Cases of Fractured Porcelain Crowns.—The method just described can be applied to advantage at times in the case of an incisor or cuspid all-porcelain crown which has been broken off, leaving its post extending from the end of the root.

The S. S. White, Dentsply, Ash or Justi Crown on a Capped Root. Any of these crowns can be advantageously set on a platinum cap in the following manner: Cap the end of the root, using platinum instead of gold to form the cap, and a round iridio-platinum post instead of a manufactured post. Solder post to cap with a little pure gold or platinum solder. Grind and fit a detached-post crown in proper position on cap, with a V-shaped space cut out of each of the sides, as shown in Fig. 1018. These spaces are for the purpose of permitting the porcelain body to be properly placed and baked around the post and between the cap and crown. When the crown is fitted to the position it is to assume on the cap, the porcelain should rest on or touch the cap at a labial and a palatal point to steady it during the first baking of the body.

To attach the crown and cap together for the first baking place some

of the body mixed thin in the post-hole of the crown, and settle it to place on the post and cap and absorb the moisture with bibulous or blotting-paper. At this stage the crown may be adjusted in the mouth to positively assure its correct alignment. It is then carefully removed



FIG. 1018.



FIG. 1019.

and baked. The heat applied should be sufficient only to biscuit the body. It should then be adjusted in the mouth and any necessary trimming or polishing done, the parts thoroughly cleaned, and the final applications of body made. Fig. 1019 shows the finished crown.

All-Porcelain Jacket Crown

The crown is formed on a cone of platinum foil that is removed after the porcelain jacket or crown has been baked. The tooth is trimmed and shaped to the form, as shown in Figs. 1020 and 1021, with a shoulder



FIG. 1020.



FIG. 1021.

or ledge at the cervix just sufficient to make an even joint with the edge of the porcelain jacket or cap. This shoulder is necessary, as it gives to the porcelain an edge that will not chip in removal of the matrix. In the finished crown, if its sides are made flush with the root, the result will be a non-irritating joint to the tissues. Form a copper tube that fits under the gum beyond the shoulder; take an impression with compound in the tube, chill, remove and form an amalgam die. Taper off the shank of the die, take an impression and "bite" with wax,

fit the die in the part representing the tooth and run models. The die will then be found in the same position as in the mouth.

Remove the die and with a wire measure the circumference of the tooth at the untrimmed cervical section (Fig. 1022). Cut a piece of $\frac{1}{1000}$ platinum foil about three-eighths of an inch wider than the length of the trimmed portion of the tooth from the shoulder to the point and one-sixteenth of an inch longer than the measure. Cut the corners as shown at the dotted lines CC, Fig. 1023. Wrap the platinum around



FIG. 1022.

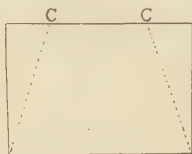


FIG. 1023.



FIG. 1024.

a cone-shaped instrument or mandrel with the large end lapped about one-thirty-second of an inch. Remove the platinum and seize at the seam at the large open end with a clamp, as illustrated in Fig. 1024, and towards the small end close to the edge unite the seam with a mere particle of pure gold, as indicated at G.

The cone, which is slightly larger than the cervix of the tooth, is now slipped over the die and pressed down as far as it will go (Fig. 1025), first by finger pressure and then by pressure of cotton wrapped around it, and the platinum is brought as closely as possible to its form. Burn-



FIG. 1025.



FIG. 1026.



FIG. 1027.



FIG. 1028.

ish the sides by moving the burnisher toward the neck, not sidewise. Close the small end by pinching it together and bending it down, then cut off the surplus (Fig. 1026).

To bring the platinum into the groove on the die, use a cord or annealed copper wire about gage No. 26 and burnishers, annealing frequently (Fig. 1027). Remove the cone from the die, seize it on the side opposite to the seam and direct the flame so as to draw the particle of gold first applied along the seam and entirely unite it. At the shoul-

der trim the overhanging edge to one-thirty-second of an inch surplus (Fig. 1028). The cone may now be adjusted on the tooth to determine its accuracy.

The porcelain section is formed either by the use of a porcelain veneer and body or with porcelain body alone.

Application of Veneer and Porcelain to Cone

To Form a Veneer.—Select a vulcanite tooth or a detached-post crown a shade darker than will be required, as the heat will lighten it. If a tooth, remove the pins and with carborundum wheels and cones grind it until only a thin veneer is left (Fig. 1029), which will fit in correct position over the cone, as shown in Fig. 1030. If the outer surface of the veneer does not conform well to the contour, grind the porcelain to the required form and polish its surface. Place the ve-



FIG. 1029

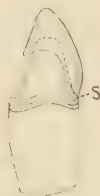


FIG. 1030.



FIG. 1031.

neer in the muffle of the furnace and heat to a point that will re-gloss the porcelain, which will be about 2300° F., then reapply the veneer to the cap. A slight space should be left between it and the shoulder at the point S.

The veneer and cap are washed clean, replaced on the die, and the veneer is secured in position on the cone with a small piece of wax placed on the lingual side (Fig. 1031). Porcelain body mixed thin is applied first on one side and then on the other, the die being slightly jarred and the moisture absorbed by blotting paper.

For the first bake, at least, no body should be placed in the groove at the shoulder, G G, Fig. 1032. The wax is removed from the back of the veneer by softening it with a heated instrument, and the cap and veneer lifted off the die by pressure under the overlap shoulder with a pointed instrument, and placed on pulverized silex on a slab with the face of the veneer resting on the silex, as shown in Fig. 1033. The first bake should be only a low biscuit bake, which will not cause adhesion of the silex to the veneer. Heat the crown very slowly or the moisture will form steam and blow or separate the cap from the

veneer. Gradually move the crown into the muffle. When biscuited and cool, adjust the crown on the die: Correct any changes caused by shrinkage in the baking and again burnish the platinum into the groove around the shoulder. Apply additional body sufficient to give the crown the desired form and a slight excess to allow for shrinkage. Pass the point of a fine broach or needle around the surface to leave a minute space between the body and the platinum.

Stand the crown, this time upright on the silex, and give it a good biscuit bake. On removal, again adjust on the die and burnish the platinum at the shoulder. Fill in the seam at the shoulder with body, and, elsewhere if needed, and give the crown the fusing or final bake. Fig. 1034 shows the crown before the matrix is removed.

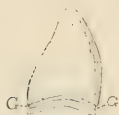


FIG. 1032.



FIG. 1033.



FIG. 1034.

Formation of Porcelain Crown without a Veneer.—Place the cone on the die and apply and shape over the entire surface to the desired form of the crown. Next with the point of a thin spatula, cut a groove between the porcelain body and the platinum forming the shoulder, entirely around the cone, as shown at GG, Fig. 1032, to prevent shrinkage in the first baking from drawing the platinum at that point. Remove the cone from the die and set upright with the shoulder resting on silex on a tray, and bake. After baking, adjust on die and burnish at the shoulder. Apply more body, fill in seam at shoulder and give second baking. Again adjust on die, apply any necessary body and give the final or fusing bake, which should gloss the surface properly.

Removal of Matrix or Cone.—The matrix or cone is removed by pulling from the edge with stiff pointed tweezers. This should be done carefully so as not to fracture the porcelain edge; avoid especially letting the tweezers slip.

Cementation.—Before cementing, etch the cavo-surface of the crown with hydrofluoric acid to afford a better adhesion for the cement. The cement should be mixed to the consistence of a thick cream, which will not require much force to bring it to position on the tooth. The setting should be done with a slight rotary motion to allow the excess to press out. The crown when set should be held under pressure for at least five minutes.

The Overlap Crown

This consists of a porcelain facing that covers the labial surface and overlaps the approximal sides and incisal portion of a natural crown, leaving the lingual side uncovered. It is applicable to special cases of defective labial surfaces.

The labial side and incisal edge of the natural tooth are first trimmed as shown in Fig. 1035, and the approximal sides as represented in Fig. 1036. A matrix of platinum foil $\frac{1}{1000}$ is shaped to fit the trimmed section extending around on the sides for stability. A very thin veneer is fitted to the labial section and first attached with body. The sides are then shaped in three bakings.

Another method is to form the entire crown of the porcelain body alone without a veneer. After the first baking correct any changes caused by shrinkage in the baking, again burnishing the platinum into



A

FIG. 1035.



B

FIG. 1036.



FIG. 1037.

the grooves around the shoulder. A, Fig. 1035, shows the labial aspect of such a crown or facing and B, Fig. 1036, a side view. Fig. 1037 shows the finished overlap crown.¹

Crowning of Roots Decayed Apart at the Bifurcation

The crowning of roots decayed apart at the bifurcation is better accomplished with platinum and porcelain than by any method with gold. The method of procedure is as follows: The sides of the roots are trimmed in parallel lines and then slightly tapered well under the gum margin, as shown in Fig. 1038. Platinum collars, gage 38 to 40—the lighter gage for very small roots—are made for each root and a floor added of platinum, gage No. 36. A plaster impression is taken that

¹ Suggested by Dr. C. H. Land and described also by Dr. W. A. Capon.

will remove the caps in position. A model is run of investing material and the impression removed. The two caps are joined together with a bar of platinum wire—the ends slightly flattened—extended across the floor of each cap, and soldered with pure gold or platinum solder as shown in Fig. 1039.

The united caps are fitted on the roots and a combined “bite” and impression taken in compound. A little of the compound should be placed between the caps so that it will press on the gum septum. The

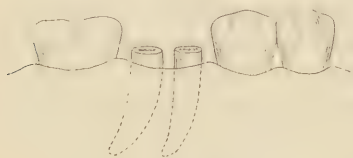


FIG. 1038.



FIG. 1039.

caps are veneered inside with paraffin, and a plaster model and articulation made. The united caps are then removed and cleaned.

Using the caps and bar as a foundation, a porcelain crown is formed. This is facilitated by first encircling the caps with a matrix of $\frac{1}{1000}$ platinum and shaping it to the form of the required crown. It should be burnished over and against the occlusal third of the approximal teeth if present, to insure a knuckling of the finished crown, as shown in Fig. 1040. The matrix formed by this band is filled with a very high-fusing body and baked. The porcelain body should be given only a



FIG. 1040.



FIG. 1041.

biscuit bake until the form of the occlusal surface and the other parts is definitely shaped, then the final bake can be given. The porcelain body should be placed under the bar between the caps at the point A, so that the porcelain in the finished crown shall press on the septum of the gum there and prevent invasion of particles of food. Sufficient of the plaster of the model should be removed at this point to admit of the application of porcelain and not interfere with the adjustment of the crown on the model during the construction. On removal of the matrix any imperfect points may be trimmed and polished or added to with a lower-fusing porcelain body. Fig. 1041 shows the finished crown.

The presence of the porcelain that touches or presses on the tissues will be benignly accepted by them and they will contract around it.

• Comments on Grades of Porcelain

The success of many operations depends on the grade of porcelain used. Proportionately the higher the fusing-point of a porcelain, the better it maintains its integrity in the mouth. The low-fusing body that is used in inlay-work on account of its easy manipulation, is entirely unsuited for operations in crown-work. The use of a high-fusing body as a foundation and finishing with a lower-fusing simplifies the construction but detracts from the strength.

The strongest dental porcelain is that used in the manufacture of artificial teeth. To obtain in crown-work an equal strength, the same body must be used and sufficient heat applied to fuse it.

Compounding Artificial Tooth Body.—Porcelain tooth-body suitable for this work is obtained by selecting diatonic teeth of classified shades and finely pulverizing them in a wedgewood mortar. The teeth of each shade are first crushed into small pieces and those forming the blue and yellow sections of the tooth separated and ground separately in a wedgewood mortar. When pulverized, the two shades of the body should be placed in separate boxes and labeled according to the shade. New shades may be made by mixing the same as described in the lower-fusing bodies.¹

In the formation of an entire crown with this body, yellow is used as the foundation and blue chiefly for the surface and cusps. When a veneer is used, the body is correspondingly applied under and around it.

The advantages of the use of porcelain teeth in this manner are:

1. The greatest possible strength of the porcelain is assured.
2. There is less shrinkage.
3. When used in connection with a porcelain veneer there is less liability of cracking it, as the shrinkage of the veneer and body is the same.
4. It withstands repeated fusings better.

For the reasons enumerated, artificial tooth body is preferable for use in porcelain crown-work, especially for jacket crowns made entirely of the body, and overlap crowns.

¹ Method suggested by Dr. C. H. Land.

PART VII

CROWN-, BRIDGE-, AND PORCELAIN-WORK
COMBINED WITH OPERATIVE DENTISTRY
IN DENTAL PROSTHESIS

CHAPTER I

OPERATIONS IN DENTAL PROSTHESIS

In crown- and bridge-work, artistic skill on the part of the operator can frequently be most advantageously displayed in the conduct of operations. An appearance of symmetry should be imparted as much as possible to the upper front teeth. The contour of the arch, the labial aspect and length of the teeth, singly and collectively, on one side of the mouth in comparison to those on the other, should be observed and studied. That most appreciable results are thus possible of attainment is demonstrated in the following two cases:

Symmetry.—In the case presented in Fig. 1042, that of a gentleman of about sixty-two years of age, is to be seen the irregularity of the teeth present and the unevenness of their incisal edges and occluding surfaces, the condition having arisen from the combined effects of decay,

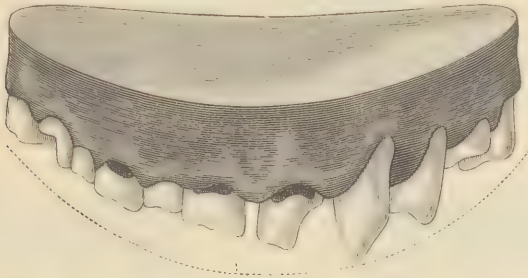


FIG. 1042.

erosion, mechanical abrasion, and malocclusion. The operations performed were as follows: On the right side the second molar was restored by filling; the first molar and the bicuspid crowned with gold; the cuspid and central were lengthened with solid gold tips, each tip being anchored with three pins; and the lateral was crowned—at the request of the patient—with gold. On the left side the central was crowned with a gold crown with porcelain front, the cuspid shortened and filled on the palatal side, and the bicuspid crowned with gold and the spaces bridged.

Guided by a line at right angles to the median line (Figs. 1042 and 1043), the teeth and crowns on one side were formed to correspond as much as possible in length, shape, and appearance to those on the other. Those teeth affected with pyorrhea were treated. The results of these combined operations, conducted with a view to the artistic as well as the restorative effect, are plainly to be seen in the finished case illustrated in Fig. 1043.

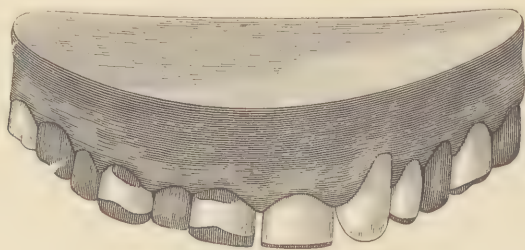


FIG. 1043.

What can be quickly accomplished by judicious trimming and shaping of the teeth, in combination with other operations, is well illustrated in the following case: The patient's upper front teeth presented the appearance shown in Fig. 1044. The right central and left lateral were pulpless. The central was badly discolored and the lateral slightly so. The central had been bleached, but in a few years gradually resumed its former appearance. The other teeth with living pulps and

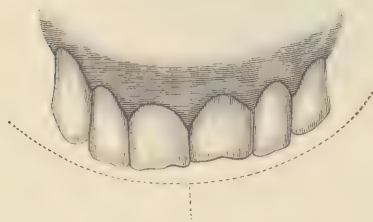


FIG. 1044.

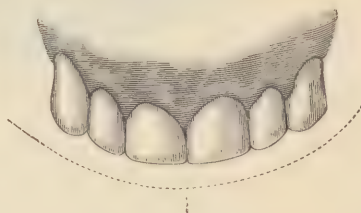


FIG. 1045.

light in color contrasted most unfavorably. The incisal edges of the centrals were affected with atrophy. The laterals, especially the right one, were elongated from pyorrhea. The length of the incisors contrasted unfavorably with the cuspids. The patient, a lady, was so annoyed at the appearance of the teeth, which she considered a permanent disfigurement, that she had positively decided to have all the incisors crowned or extracted and artificially replaced. A most

satisfactory compromise was effected, enabling the patient to avoid either of these extreme measures by the performance of the following operations: The pyorrhea was treated, the left lateral was bleached and refilled, the right central natural crown excised and an artificial one inserted, and the atrophied incisal edge of the left central removed, all the incisal ends of the other teeth being trimmed to properly correspond in length and shape. The improvement effected is apparent in the illustration of the finished case, Fig. 1045.

The method of procedure respecting trimming and shaping as described in these cases might often be applied advantageously in cases of fracture of the incisal edge of front teeth too small to reliably restore with porcelain.



FIG. 1046.

The results in dental prosthesis which can be accomplished by a combination of operations on the natural teeth with crown- and bridge-work commend the plan strongly to the experienced practitioner. A few more cases are adduced in illustration.

Cases Showing the Results of Combined Operations.—A case which was interesting, owing to the conditions presented and the various operations connected with it, is illustrated in Fig. 1046. Fig. 1047 shows the methods and operations practiced, and Fig. 1048 the case completed.

The upper front teeth show the effects of abrasion on the incisal edges and occluding surfaces. The bicuspid and molars were affected with pyorrhea alveolaris. The four incisors and the left cuspid were pulpless, and alveolar abscess existed at the roots of three of the incisors. The abscesses and root-canals were properly treated. Gold collar crowns with porcelain fronts, having flat incisal edges which perfectly protected the porcelain fronts and slightly opened the bite,

were made for the incisors and left cuspid (Fig. 1047). The bicuspid and molars were placed in as hygienic a condition as possible by treatment. On the left side a pontic bicuspid with a bar which fitted in a slot formed to receive it in the occluding surface of the second bicuspid was attached to the cuspid crown. When the cuspid crown with the pontic bicuspid was cemented in position, the bar was anchored in the slot in the second bicuspid with amalgam. The cuspid root being very firm, stability was thus imparted to the natural bicuspid, which was quite loose because of absorption of its socket. On the right side the second bicuspid was entirely capped with a gold seamless crown.

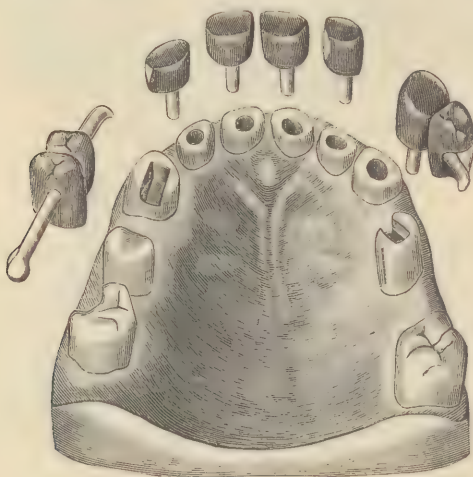


FIG. 1047.

On the anterior side of this gold crown an artificial tooth was attached as a pontic first bicuspid, with a bar extending from its anterior side and fitted into a slot formed in the incisal surface of the natural cuspid crown. From the posterior side of the second bicuspid gold crown a bar was extended backward into the side of the molar. When the gold crown was cemented in position on the second bicuspid, the anterior bar was firmly anchored in the cuspid with a gold filling, which also lengthened the incisal edge, and the posterior bar was fixed in the molar with amalgam. The reasons for this form of construction were: The second bicuspid was very loose in its socket, and the molar, though comparatively more stable, was also similarly affected. The attachment of the bar in the cuspid supported the pontic bicuspid and steadied the second bicuspid, and the extension of the posterior bar into the molar likewise afforded additional support to the bicuspid. The

pulp of the molar being exposed, was devitalized, removed and the canals properly filled. Fig. 1048 shows the completed case.

The lower teeth, in comparison with the upper, were but slightly abraded. The cuspids and one of the incisors were tipped with gold.

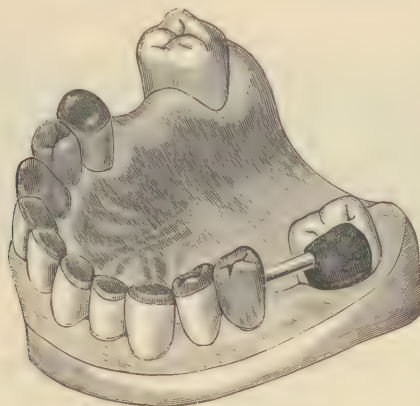


FIG. 1048.

The molars on the left side were absent, so that bridge-work on the upper jaw on that side between the bicuspid and molar would have been to no purpose.

Fig. 1049 illustrates a case as presented for treatment.

The loss of the posterior teeth of the lower jaw and the abrasion of the anterior teeth had resulted in the abnormal occlusion shown.

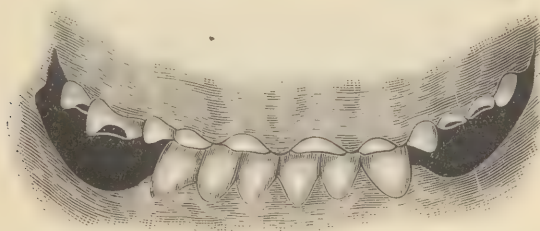


FIG. 1049.

The incisal edges of the lower teeth were lengthened with gold contour fillings. Gold collar crowns with porcelain fronts were placed on the upper anterior teeth, to lengthen them sufficiently to restore the occlusion. The upper molars, which were all more or less decayed and broken down, were restored in form with gold crowns. The space rep-

representing the loss of the left bicuspid was filled with a bridge tooth having a porcelain front, attached to the approximal gold crown. In the mandible a partial set was inserted on each side to substitute the lost posterior teeth. Fig. 1050 shows the appearance of the case when completed.



FIG. 1050.

Bridge-Work with Functional Movement¹

Fig. 1051 shows the replacement of an inferior second bicuspid and first molar with a fixed bridge, the pulps of the abutment teeth being conserved. The cuspid and first bicuspid form the anterior abutment and the second molar the posterior one.

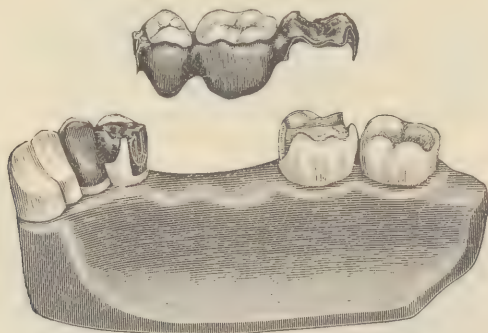


FIG. 1051.

A three-pin inlay attachment was made for the lingual side of the cuspid and a mesial-occlusal-distal attachment for the bicuspid. These two attachments were united, leaving the cervical third open to furnish space for the normal presence of the gum septum.

On the distal side of the bicuspid attachment a small oval V-shaped socket of retaining form was made to receive a correspondingly shaped male attachment to the anterior end of the bridge as a supporting

abutment. A mesial-occlusal-distal inlay was cemented in the molar abutment. Fig. 1052 shows the completed bridge cemented in position.

In this form of construction the posterior abutment securely retains the bridge while the anterior one supports and allows it a slight resilient mobility in the act of mastication, or as expressed by some writers "Movement in Function."¹

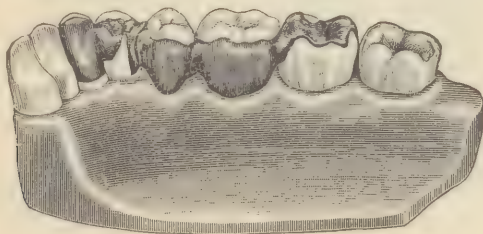


FIG. 1052.

Gold and Porcelain Sanitary Bridge

In the case presented in Fig. 1053 the loss and long-continued absence of the inferior right second bicuspid and first molar caused the occluding teeth to elongate and the inferior incisors to occlude so forcibly on the lingual side of the superior incisors as to slightly spread them. The patient consented to the artificial restoration of the bicuspid and molar, but only on condition that no considerable mutilation of the abutment teeth should be necessary.

Sufficient space for the collar of a cap for the first bicuspid on the mesial side was obtained by wedging and a slight removal of the contour. The distal side was removed sufficiently to parallel it. At the occlusal surface space for the presence of a cap was obtained by removing a portion of the cusps and a goodly part of the surface of a filling in the antagonizing tooth. As the second molar tipped forward, its distal side needed very little trimming, but the mesial surface required quite a little reduction to bring it sufficiently in line with the first bicuspid. On the occlusal surface the cusps were reduced and considerable material ground off the surface of a large amalgam filling in the occluding superior molar.

Impressions were next taken of the occlusal surface and sides of the bicuspid and molar and short caps were struck up of pure platinum, gage No. 38, trimmed to a depth and form at the sides that would permit them to be inserted and removed when united to the bridge. Over the occlusal surfaces of these caps were melted and flowed a few par-

¹ Case of Dr. James K. Burgess.

ticles of pure gold, enough only to slightly modify the color of the platinum. Next over the surface of the caps supplementary caps of $\frac{1}{500}$ platinum were struck. These supplementary caps were trimmed one-sixteenth of an inch smaller at the edges and then perforated with punch forceps and re-swaged over the first caps. The caps were then subjected to a white heat with the blowpipe, which caused the film of pure gold on the surface of the first cap to unite them. The cavo-surface of the caps was painted with rouge and clasp gold flowed over their surfaces in quantity sufficient to fill the punch holes and distribute a film over the entire surface of each cap. The edges of the caps were trimmed and polished, then cleaned and again swaged to remove any contraction from the soldering.

A hole was drilled in the deepest fissure of the occlusal surface of each tooth through the cap and a roughened wire fitted and soldered in position. The caps were next adjusted on the teeth, a "bite" in wax first taken and then an impression of plaster, which removed the caps in position, and models were made. A sanitary gold and porce-

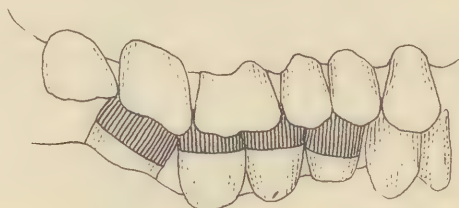


FIG. 1053.

lain bridge was then constructed, as described in Part IV, Chapter VI. When the bridge was cemented, the edges of the caps were burnished against the enamel. Subsequently when the cement was thoroughly set, a small fine-grained finishing point was run over the edge and the surface additionally polished and burnished.

To render the edges of the caps quite imperceptible to the tongue: In the construction when the edges of the caps have been trimmed to the desired form, dry the surface of the tooth and mark the lines of the edge on the enamel. Remove the caps and grind the enamel so as to slightly indent it to but beyond the line of the pencil mark. Burnish the edge of the cap into this groove.

Fig. 1053 shows the bridge viewed from the buccal side and Fig. 1054 a radiograph from the lingual. The porcelain base, also the labial and lingual sides of the pontics are incorruptible and their form is very acceptable in feeling to the tongue. Proper use of a pointed brush and floss silk will insure a hygienic condition of the mouth.

Cast partial cap-crowns described in Part IV, Chapter IV, may be used instead of the stamped cap-crown.

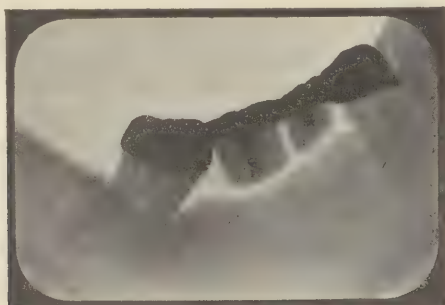


FIG. 1054.

The case shown in Fig. 1055 demonstrates the use of an approximal plate extension inlay. A lady patient lost the right first and second superior bicuspids. She wished to remedy this vacancy, which mate-

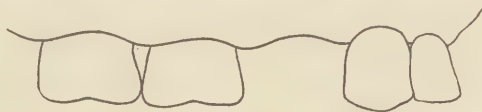


FIG. 1055.

rially disfigured an otherwise good-appearing set of teeth. The occluding teeth on the lower jaw, owing to the absence for many years of the upper antagonizing ones, had elongated, and gave but little room for

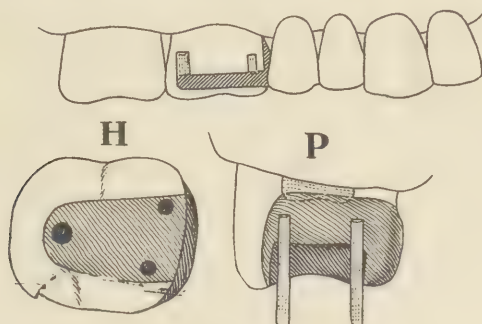


FIG. 1056.

an occluding surface for the artificial substitutes. Under the conditions present, and the fact that the patient only desired to improve the appearance and declined to allow the cuspid to be cut into for support, the author constructed an extension bridge, supported by an inlay,

which contained three pins and partly capped the mesial side of the molar. The mesial pins were of gage 20. The distal pin, gage 17, was inserted as deeply into the posterior section of the dentin as it could be placed without endangering the pulp, to obtain a secure attachment and resist the leverage exerted by the bridge. A lug rested

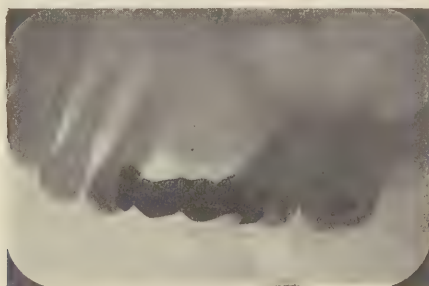


FIG. 1057.

on the lingual side of the cuspid. Fig. 1056 shows the construction, H the position of the holes for the pins and cavity to receive the inlay, and the line of the partial cap. P illustrates the line of the two mesial pins and also the partial cap. Fig. 1057 is a radiograph taken nine years after the operation.

Combined Partial Root and Crown Replacement with Porcelain.

Partial root replacement, as well as root crowning, was involved in the



FIG. 1058.

case shown in Fig. 1058, a left inferior molar the roots of which were decayed apart at the bifurcation. An examination showed the mesial root suitable for capping, but the distal was destroyed by decay to the edge of the alveolus, a condition in the case of a molar that seemed to preclude the possibility of a crowning operation on both roots. When the patient was so informed she made an urgent plea that some plan be devised to retain and utilize both roots and artificially restore the crown.

The operation performed in detail is as follows: Both root-canals were found to be entirely calcified. The sides of the mesial root and the projecting end were trimmed to slightly taper, a post was inserted

in the root for stability and a closely fitting collar of pure platinum, gage No. 38, was made. The decay on the end of the distal root when removed disclosed that the remainder of the dentin was dense and the root-canal completely calcified. As the patient refused to have a radiograph taken, a hole was drilled, guided by the position and apparent shape of the root, deep and large enough to receive and anchor a closely fitting iridio-platinum post, about gage 15, that had previously been rolled under a file to roughen it. By means of several packings of gutta-percha the end of the root was fully exposed. The post, surrounded with impression compound, was introduced, an impression of the end taken and an amalgam die made with the post in position. By means of this die, the post having been removed, a plate for the end of the root was made, its center punctured and the post inserted, cemented with wax, removed and soldered to the floor with a particle



FIG. 1059

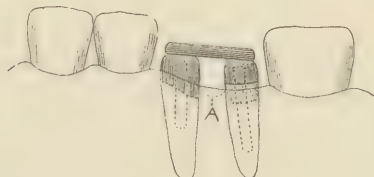


FIG. 1060.

of pure gold. The edge of the plate was trimmed uniformly even with the edge of the end of the root. The post and floor were adjusted on the root and the extension of the post slightly bent to parallel it with the line of the sides of the mesial root.

On the floor and around the post a porcelain extension of the root parallel with the mesial root collar was made of high-fusing porcelain body, using a platinum foil matrix that was removed when the baking was completed (Fig. 1059). A platinum collar was made for the porcelain root extension similar to the one for the mesial root. The porcelain extension to the root was then divested of the collar, cemented on the root and allowed to remain a week for the membrane of the gum to contract and assume normal position upon it. The platinum collar was adjusted and the cervical portion trimmed to leave a space of one-sixteenth inch between the edge of the collar and the gum margin. The ends of the two collars were trimmed even and the floors added. The two caps were then connected with a bar (Fig. 1060), and the crown section made with the porcelain pressing on the septum of gum between the roots (A), as described in Part VI, Chapter VIII (Figs. 1038 to 1041).

Fig. 1061 shows the completed crown and Fig. 1062, a radiograph which the patient finally consented to have taken about six years subsequent to the operation.

In cases where pyorrhea alveolaris exposes the bifurcation between the roots of a molar, forming a pocket which fills with extraneous matter



FIG. 1061.

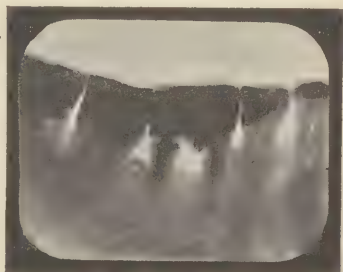


FIG. 1062.

and consequently acts as an incentive to the destruction of the investing membranes, the author has quite effectively retarded the progress of the disease by the following treatment, described as practiced on a lower molar. In this case a pocket had formed between the roots from disintegration and absorption of the tissues in such a manner as to leave an open space that it was not possible to keep clean. As the



FIG. 1063.



FIG. 1064.

tooth was pulpless, a cavity was made at an angle in an occlusal direction as shown in section at A, Fig. 1063, of a size and shape sufficient to receive and retain a porcelain inlay that would fill the cavity and also the open space between the roots, as shown in Fig. 1064. The pocket being thus removed, the tissues contracted over the part.

Inlay Restoration in a Close Incisal Occlusion.—In cases of fracture of the incisal edge of a central incisor, for example as shown in Fig. 1065, where a close occlusion or “bite” exists, as indicated in Fig. 1066, artificial restoration of the part can generally be best effected by the use of a gold inlay for stability, faced with one of the silicate cements or porcelain for appearance.

In the case shown in Fig. 1065 a secure anchorage was obtained for the gold inlay by its insertion in a linguo-labial direction by forming an anchorage in the lingual side, as shown in Fig. 1067. A portion of the wax on the labial side of the wax model of the inlay was removed (A, Fig. 1068). When the casting was made and fitted, the gold was removed so as to form a labial cavity with an undercut edge suitable for a silicate cement filling. The straight mesial wall of the fracture formed the distal side of the cavity for the filling. After the gold inlay



FIG. 1065.



FIG. 1066.

was cemented to position and the cement had set, the surplus cement that oozed into the cavity formed for the filling was removed and a silicate filling inserted. In course of time when the silicate cement becomes impaired in condition or shade, it can be easily removed and renewed.

In the case described if porcelain is inserted instead of silicate cement, the gold inlay requires to be cast of gold alloyed with enough platinum to insure against its melting in the fusing of the porcelain.



FIG. 1067.



FIG. 1068.

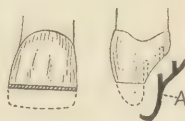


FIG. 1069.

Fracture of an Incisal Edge.—Fig. 1069 shows a method of repairing a fractured incisal edge of a superior central with a vital pulp, where the fracture was too small for the application of porcelain. A three-pin plate was made for the lingual side that extended over the incisal edge as shown at A. The vacant space was then filled with silicate cement. This cement can be easily removed and replaced in time when conditions suggest.

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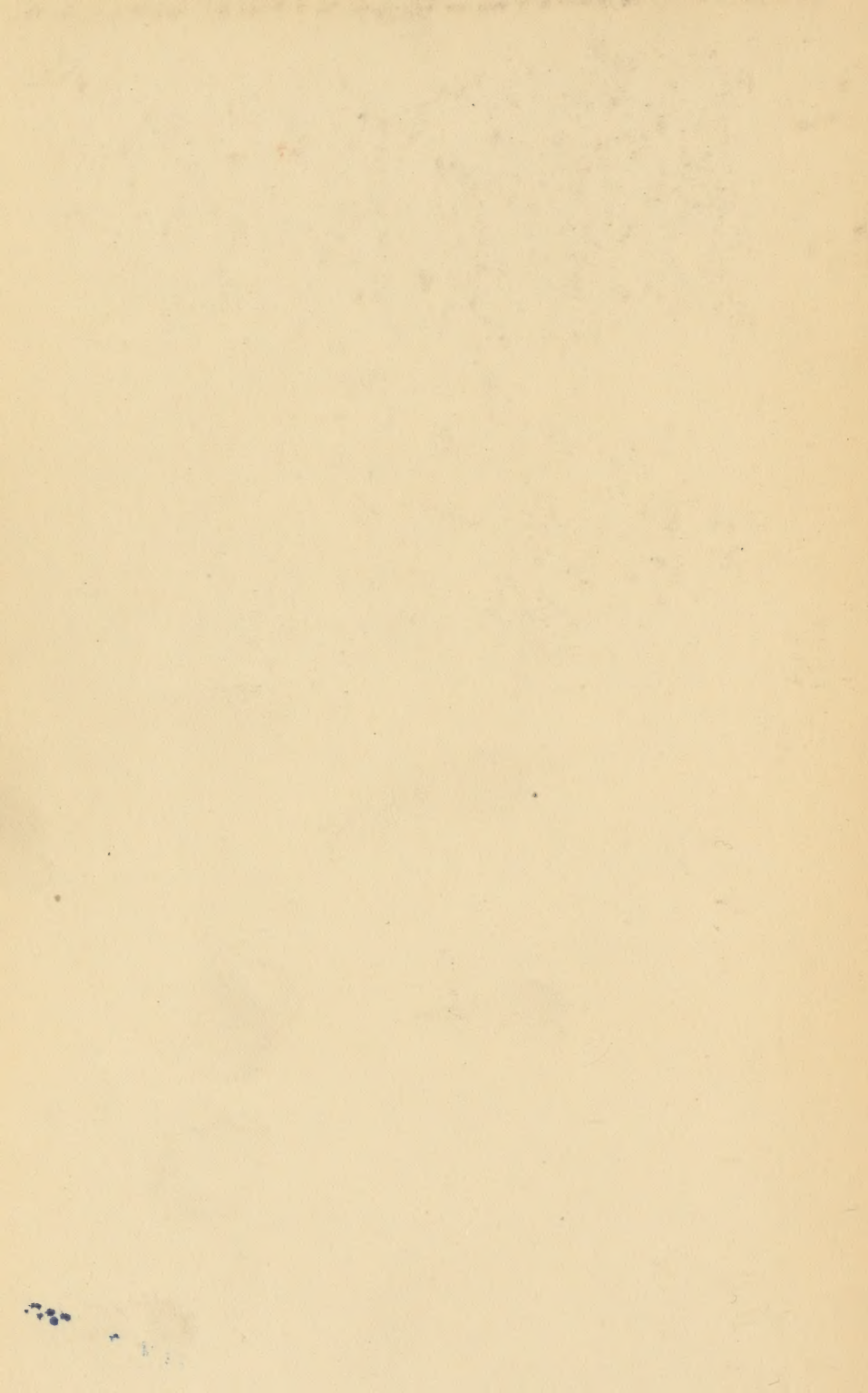
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